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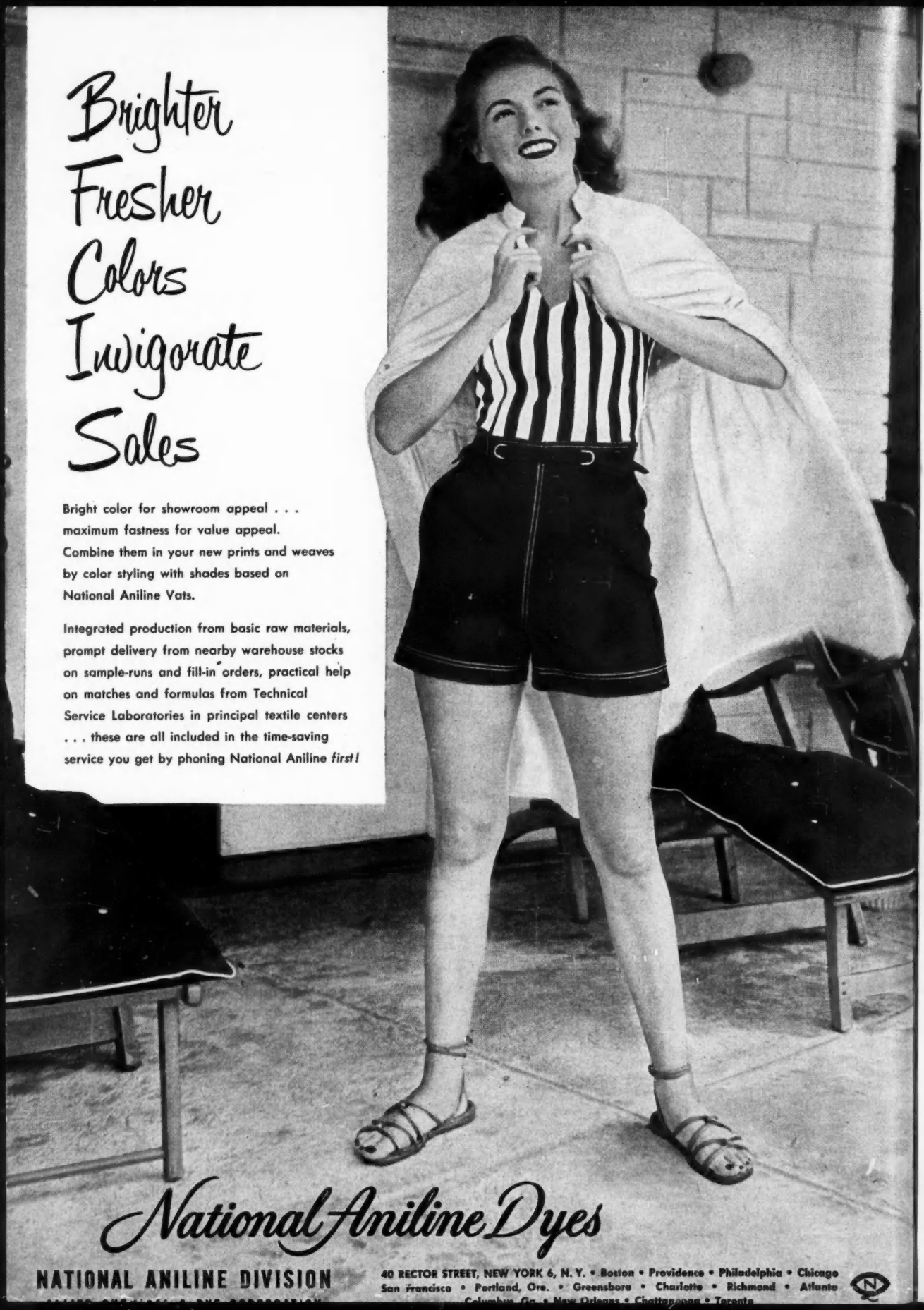
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AMERICAN
DYESTUFF REPORTER

VOLUME 41 December 22, 1952 NUMBER 26

PRINCIPLES OF DYEING "DACRON" POLYESTER FIBER*

W R REMINGTON

Jackson Laboratory
E I du Pont de Nemours & Co, Wilmington 99, Delaware

A FEW YEARS ago, this talk would have gone something like this: "There is no class of dyes which will dye 'Dacron' polyester fiber. It is so inert and has such a compact structure that it may be considered undyeable". In the intervening years, the picture has slowly changed. We have experimented with a great many dyes and dyeing methods, and although there have been numerous failures, we now have several fundamentally different ways of applying dyes to "Dacron". Also, we have gained some insight into how and why these procedures work.

Even in the beginning, we knew that there was considerable chemical similarity between "Dacron" and acetate. Ester groups (-C-O-) constitute 41% of the weight of acetate, and 46% of the weight of "Dacron". By now, we have achieved a good grasp of the chemical principles governing the dyeing of "Dacron" polyester fiber.

Probably, it will be most instructive for us to examine the dyeing of "Dacron" in comparison with the dyeing of acetate. It has been found that these chemically similar fibers are receptive in aqueous dyeing to the same general type of dye. This is the dispersed type, which comprises the "Acetamine", "Celanthrene", and "Latyl" dyes.

Let us consider first, then, what actually occurs when any fiber is dyed with a dispersed dye. In the dyebath, such a dye breaks up into very small "dispersed" particles, about a ten-thousandth of an inch in diameter. Although these particles are far too small to be seen, each contains about a billion dye molecules. In the dyeing process the dye molecules break off, apparently one at a time, from the particles of dye, are carried through the water and reach the surface of the fiber. The single dye molecules then ap-

* Presented at Du Pont Technical Conference, Wilmington, Del, August 5, 1952. Jackson Laboratory Contribution No 130.

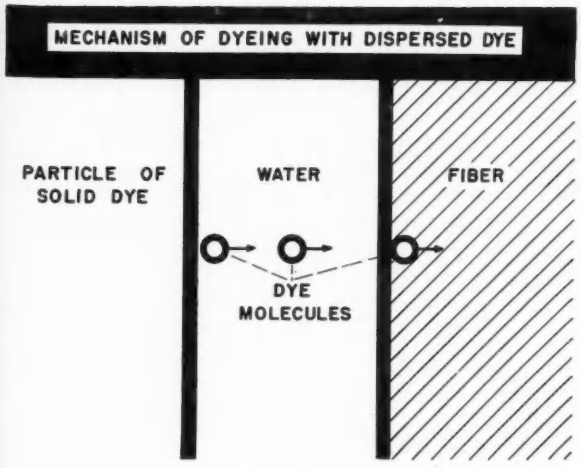

Figure 1
Mechanism of Dyeing With Dispersed Dye

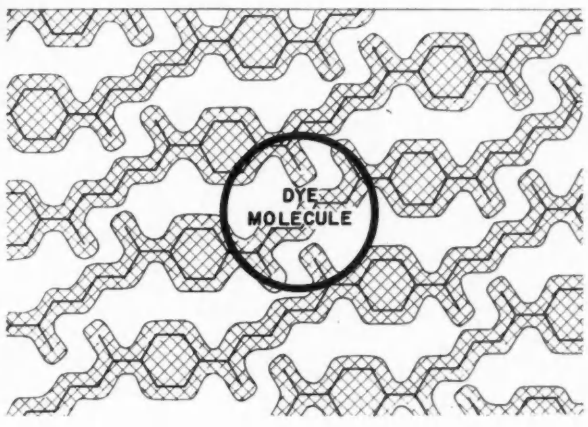

Figure 2
"Dacron" Polyester Fiber and a Dye Molecule

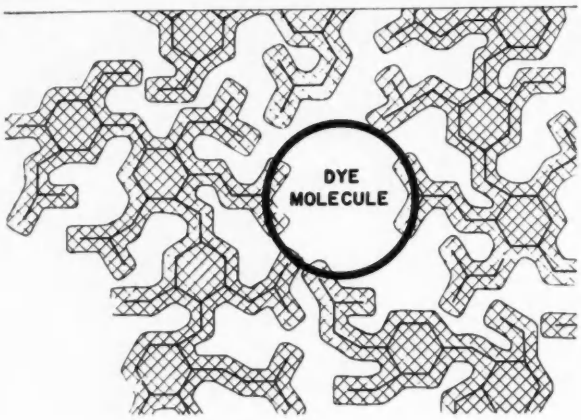

Figure 3

Acetate Chains and Dye Molecule

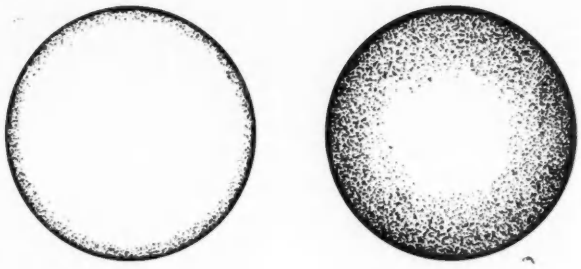

Figure 4

Sections of "Dacron" Polyester Fiber Showing Dye Penetration

parently enter the fiber by dissolving in it and diffusing through it. Figure 1 is a representation of this process, magnified about 100,000,000 times. This is what happens during a dyeing in which dispersed dyes are used, and it goes on in the same way whether the fiber is "Dacron" or acetate. But we know that, in spite of all this, it is much more difficult to dye "Dacron" polyester fiber than to dye acetate.

Apparently, the reason for this fiber's comparative reluctance to accept dyes results from its closely ordered, compact internal structure. Incidentally, the great virtues of "Dacron" as a textile material are also dependent upon this closely ordered structure. But let us examine what we mean by a closely ordered structure.

Figure 2 is a representation of "Dacron" polyester fiber based upon information gained from X-ray diffraction studies. Like Figure 1, it is magnified about 100,000,000 times. The long chain molecules of which "Dacron" is composed are arranged in a neatly packed zig-zag pattern. Not only are the molecules arranged like this, but they quite definitely do not want to be disturbed from these positions. The dye molecule, too, is drawn approximately to scale. It is easy to see that this dye molecule is going to have a very difficult time penetrating this neatly ordered array of polyester molecules.

In contrast, as shown in Figure 3, the molecular chains of which acetate is composed appear to be in a terribly snarled condition. They are not designed to fit together as neatly as the chains in "Dacron" polyester fiber and furthermore, they appear to be much more free to change their positions. Clearly, in a situation like this, the dye can penetrate the fiber much more easily.

Our problem in dyeing "Dacron" polyester fiber, then, results from the compactness of the structure, which prevents dyes from diffusing through it rapidly. Of course this reluctance of the fiber to let the dye travel through it does bring about one excellent result almost automatically—a high degree of wash-fastness. Once we get our dye molecules inside this fiber they can get out only very slowly. As a result, good dyeings on "Dacron" show wash-fastness comparable with that of vat dyeings on cotton. This wash-fastness results no matter what means are used to get the dyes into the "Dacron," since they do not seem to remember how it was that they were forced to enter the fiber.

Now, let us consider how dye molecules can be induced to travel rapidly the difficult path from the dyebath to the interior of the "Dacron" polyester fiber. One way might be simply to lubricate the interior of the fiber, that is, to let the dye molecules and "Dacron" chains slip about more readily. Apparently carriers act in just this way. As shown in Figure 4, a dispersed dye will penetrate "Dacron" about five times as fast when a carrier is used as when no carrier is present. As a result, the dyebath is exhausted much more rapidly when a carrier is present than when it is absent.

Thus carriers solve the problem of causing "Dacron" to be dyed more rapidly, but there are some disadvantages which result from the use of carriers. Some of them are unpleasant to work with because they are toxic. For example, monochlorobenzene would be a very desirable carrier, but it distills from the bath during dyeing and unless there is excellent ventilation, its toxic fumes are dangerous. On the other hand, orthophenylphenol, which is among the most attractive carriers from the point of safety and economy, sometimes has a bad effect on the light-fastness of dyes unless it is completely removed by scouring; and this is difficult. Probably, the best carrier is benzoic acid, since it is easy to use and easy to remove from the fiber, but it is rather expensive.

All these difficulties can be avoided by dyeing at about 250° F. At this temperature the chain molecules of which "Dacron" is composed apparently jump around so vigorously that there are momentarily formed gaps big enough for a dye molecule to pass through. That is, at this temperature "Dacron" polyester fiber behaves in about the same way that acetate behaves under normal dyeing conditions. Using high temperatures, then, is simply another way to make the dye molecules travel more rapidly through the fiber, and it is even more effective than the best carriers. Best of all, there are no carriers to remove after the dyeing, and the dyes used retain their full light-fastness.

The advantages of high temperatures are found even more strikingly in dyeing by the "Thermosol" process. Here, the temperatures are even higher, and complete penetration is obtained in seconds *(1)*.

There is one more expedient which can help in getting dye molecules into our compact fiber, and that is to bring them in in smaller pieces and assemble them after they are inside. Sometimes, this scheme is combined with the use of a carrier. This process is in many respects similar to the application of diazotized and developed colors to cotton or rayon. The result is similar, too, in that there is formed inside the fiber a dye molecule too large to get in or out readily.

Thus, we see that the problem of dyeing "Dacron" polyester fiber is that of getting large dye molecules through small spaces between relatively immovable "Dacron" chains, and that this problem can be solved by using a carrier, by using a high temperature, or by forming the final dye molecule within the fiber.

REFERENCE

(1) Andres, R J, Gibson, J W, Jr, and Knapp, P, "Thermosol" Method of Dyeing (to be published).

THE CLEANING EFFICIENCY OF DETERGENTS AND WASHING METHODS IN LAUNDERING WOOL

MARGARET S FURRY and ELINOR M O'BRIEN

Bureau of Human Nutrition and Home Economics
Agricultural Research Administration
U S Department of Agriculture

IN a series of studies on the selection and use of detergents in home laundering, the Bureau of Human Nutrition and Home Economics has included an investigation on the laundering of wool fabrics. Recently reported (*1*) is a Bureau study of changes that occur in certain properties of a lightweight wool fabric upon repeated laundering with various detergents, using washing methods in which agitation and temperature were varied. Also reported (*2*) is an evaluation of the soil-removing efficiency of detergents in laundering an artificially soiled wool fabric chlorinated to control shrinkage. This paper is an evaluation of detergents and washing methods for cleaning efficiency on laundering unsoiled and soiled wool fabrics not previously treated for shrinkage control.

EXPERIMENTAL PROCEDURE

The detergents selected for this study include five of the six detergents used previously (*1*)—an unbuilt soap, and two unbuilt and two built synthetic detergents. All five were evaluated for their cleaning efficiency, ie, their soil-removing and whiteness-retaining ability.

For measuring the efficiency of the detergents in soil-removal, two commercially available soiled wool fabrics were used. One, a wool flannel, had been prepared by immersion in a soiling bath. The other, a worsted, had been prepared by printing or padding a 4-inch soiled strip on one side of the material.* Unsoiled portions of the latter fabric were used for determining the whiteness-retaining ability of the detergents. Neither fabric had been treated with a special finish for shrinkage control.

The immersed soiled wool cloth was cut into samples, 4 inches by 4 inches, and three replicates used for each set of laundering conditions. Samples were laundered at 0.25 percent concentration of each detergent in both distilled water and water of 300 ppm hardness, some in the launderometer with mild agitation for 10 minutes at 40°C, others with minimum agitation (soaking) for 30 minutes at 40°C. Then each sample was spread flat on plateglass with a weighted roller and when air dry, the percent light reflectance was read in two places with the color difference meter.

The printed soiled wool fabric was cut into samples, 7 inches by 4 inches, so that each sample had a printed soiled area, approximately 4 inches by 4 inches, and an unsoiled area, 3 inches by 4 inches. Three samples were used for each laundering condition. Part were laundered with mild agitation at 40°C; some were laundered with minimum agitation at 40°C; and others were washed by corresponding methods at 60°C. Then, the light reflectance of both the soiled and the unsoiled areas of each sample was read in two different places and the results averaged separately.

CLEANING EFFICIENCY ON LAUNDERING

Reflectance measurements to indicate the soil-removing and the whiteness-retaining efficiency of the unbuilt soap, unbuilt synthetic detergents 1 and 2, and built synthetic detergents 1 and 2 with mild agitation at both 40°C and 60°C and with minimum agitation at the same two temperatures are given in Table I.

SOIL REMOVAL———The average percent light reflectance of the soiled wool fabrics shows the soil-removing efficiency of the detergents under the test conditions. The higher the reflectance value obtained

TABLE I
SOIL REMOVED FROM SOILED WOOL TEST FABRICS AND WHITENESS RETAINED IN UNSOILED WOOL TEST FABRIC: EFFECT OF FIVE DETERGENTS AND FOUR WASHING METHODS.

Detergent[1]	Hardness of water	Light reflectance of fabrics laundered at—[2] 40° C: Immersed soiled wool	40° C: Printed soiled wool	40° C: Unsoiled wool	60° C: Immersed soiled wool	60° C: Printed soiled wool	60° C: Unsoiled wool
		Mild agitation for 10 minutes					
		Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Unbuilt soap	Distilled	30.3	26.1	67.1	29.6	29.3	67.0
	300 ppm	16.1	13.4	59.0	14.3	14.7	59.7
Unbuilt synthetic detergent 1	Distilled	28.4	28.5	66.4	...	28.1	65.8
	300 ppm	23.2	21.2	64.9	...	20.6	63.4
Unbuilt synthetic detergent 2	Distilled	17.3	16.2	53.8	...	16.6	58.7
	300 ppm	17.0	15.3	59.1	...	15.8	54.2
Built synthetic detergent 1	Distilled	32.0	21.2	64.2	...	21.3	65.1
	300 ppm	25.3	18.5	64.0	...	18.6	57.2
Built synthetic detergent 2	Distilled	18.4	19.5	60.1	...	24.1	66.2
	300 ppm	17.6	17.5	58.6	...	18.9	60.2
Water without detergent	Distilled	14.5	13.6	55.1	14.4	13.5	55.7
	300 ppm	14.0	13.3	59.5	14.2	13.0	51.0
		Minimum agitation for 30 minutes					
Unbuilt soap	Distilled	20.2	16.1	67.5	23.5	20.3	65.8
	300 ppm	14.7	13.8	64.1	13.8	14.3	62.4
Unbuilt synthetic detergent 1	Distilled	20.8	20.9	66.6	...	22.7	67.2
	300 ppm	18.6	17.3	66.5	...	16.8	64.3
Unbuilt synthetic detergent 2	Distilled	15.5	14.9	63.7	...	17.0	66.4
	300 ppm	16.4	13.9	65.1	...	14.3	61.3
Built synthetic detergent 1	Distilled	22.9	17.0	64.8	...	19.4	67.1
	300 ppm	19.2	16.2	66.9	...	16.8	65.3
Built synthetic detergent 2	Distilled	16.6	17.3	64.1	...	19.9	66.9
	300 ppm	16.6	15.1	65.8	...	16.6	63.6
Water without detergent	Distilled	15.2	13.7	60.9	15.2	14.9	66.0
	300 ppm	14.5	13.7	63.8	14.6	13.1	63.1

[1] Each sample was washed in 0.25 percent solution of the detergent and rinsed.
[2] Reflectance of unlaundered fabric: immersed soiled wool, 15.1 percent; printed soiled wool, 14.2 percent; unsoiled wool, 69.8 percent.

* The immersed soiled wool was obtained from Foster D Snell, Inc, 29 West 15th Street, New York 11, N Y; the printed soiled wool from Testfabrics, Inc, 55 Van Dam St, New York 13, N Y.

with the detergent, the more efficient it was in removing soil from the test material. Analysis of the data for the immersed and printed soiled fabrics showed, respectively, differences of 1.1 and 1.8 percent and above to be significant,

Agitation of the sample during laundering was for the most part more important than temperature of the wash in removing soil from the test fabrics. Throughout the various washing procedures with the detergents, slightly more soil was removed from the immersed soiled fabric than from the printed soiled. The range in light reflectance (soil removal) of the two soiled wool test fabrics washed with the detergents in distilled water by the four washing methods is as follows:

	Percent light reflectance (range)	
Washing method:	*Immersed soiled wool*	*Printed soiled wool*
Mild agitation:		
at 60° C	....	16.6–29.3
at 40° C	17.3–32.0	16.2–28.5
Minimum agitation:		
at 60° C	....	17.0–22.7
at 40° C	15.5–22.9	14.9–20.9

The order of detergents in removing soil was somewhat similar in the two fabrics; also, it was much the same in the different procedures. Results in distilled water by washing with mild agitation at 40°C showed that the soap and built and unbuilt synthetic detergent 1 were the most efficient. Next was built synthetic detergent 2, and least efficient was unbuilt synthetic detergent 2. (In the previous study (2) using the soiled test fabric that had been chlorinated, the order of detergents was similar to these results in that built synthetic detergent 1 was most efficient and unbuilt synthetic detergent 2 was least efficient in removing soil from the test fabric.)

All detergents that were tested removed less soil in hard water than in distilled water. With the unbuilt soap at the concentration used, much of the soap was needed to overcome the hardness in water and little was available for removing soil.

WHITENESS RETENTION —— The average percent light reflectance of the unsoiled area of the printed soiled wool test fabric laundered with the various detergents by the different washing procedures (Table I) is an estimate of the whiteness-retaining or soil-suspending efficiency of the detergent. That is, the value measures the ability of the detergent to keep loosened soil from settling on the fabric before it is rinsed away. The higher the reflectance value the more efficient was the detergent under the conditions used. The unsoiled, unlaundered test fabric had a reflectance of 69.8 percent. Differences in the data of 1.8 percent and above are significant.

Washing with mild agitation at 60°C was somewhat more effective than at 40°C in retaining whiteness in the test fabric. Reflectance values for these two methods using the various detergents in distilled water ranged from 58.7 to 67.0 percent and from 53.8 to 67.1 percent, respectively. In the methods with minimum agitation, since little soil was loosened for removal, little soil was deposited on the unsoiled test area. In general, the order of the various detergents in retaining whiteness in the unsoiled area of the test fabric was the same as that in removing soil from the printed soiled area.

SUMMARY

With suitable wool test fabrics, five detergents have been evaluated for their soil-removing and whiteness-retaining efficiency by washing methods in which agitation and temperature were varied.

With the detergents and under the test conditions used, agitation of the test samples during laundering was, for the most part, more effective than temperature of the wash in removing soil from the soiled wool test fabrics and in retaining whiteness in the unsoiled wool material. In general, in distilled water, the unbuilt soap and unbuilt and built synthetic detergent 1 (sodium lauryl sulfate products) removed the most soil; built synthetic detergent 2 (nonionic polyglycyl ester) was next; unbuilt synthetic 2 (sulfated glyceryl ester) was least effective of the detergents tested. The order of the detergents in retaining whiteness in the unsoiled fabric was much the same as that in removing soil from the soiled test fabrics.

LITERATURE CITED

(1) Furry, M S and O'Brien, E M, "The Laundering of Wool: Effect of Detergents and Washing Methods on Fabric Properties", *Am Dyestuff Reptr* 41, 763 (1952).

(2) Furry, M S and McLendon, V I, "Effectiveness of Detergents in Removing Soil from a Cotton and a Wool Fabric", *Am Dyestuff Reptr* 39, 209-212, illus (1950).

• PATENT DIGEST •

PADDING MANGLE—— Hard Core Rolls Covered with Thin Coating of Soft Rubber

C, 6

U S Pat 2,596,154
(Secy Agriculture——Keating J, Keating E——
May 13, 1952)

Metal- or rubber-covered rolls are generally used in textile padders. The rubber layer fixed upon the core is normally one inch or more thick; this type is generally referred to as the solid rubber roll. Whether a pair of rubber rolls or one rubber and one metal roll are used in padders, the surface of the roll cannot be deformed because no substantial flattening occurs. Consequently the force applied is concentrated on a small area at the nip and the squeezing effect is limited to this area. The padding solutions in this event chiefly fill the interstices of the fabric and fail to penetrate the fibers.

PAUL WENGRAF

The present invention suggests the use of a pair of rollers consisting of metal or any other hard core, and covered with a relatively thin layer of soft rubber. With pressure applied, the thin rubber cover deflects only slightly but is squeezed into the interstices of the weave and around the fibers. A high degree of liquid extraction and, at the same time, good penetration are claimed. The percentage pick up was measured according to the formula:

$$\frac{\text{weight of liquid retained}}{\text{dry weight of the fabric}} \cdot 100$$

Comparative figures were as follows:

Samples treated in customary padders (%)	*Samples treated with improved padders* (%)
75	47
80	44
64	47
70	35

These figures refer to bleached, mercerized and printed fabrics of various construction.

References cited by the Patent Office:

U S Pat 1,055,404 (Kremer/1913): a device for saturating a fabric with a rubber solution used in the manufacture of tires; the padding rollers consist of soft compressible material which largely flattens out under pressure.

U S Pat 1,702,140 (Courtaulds Ltd/1929): a padder for sizing artificial threads, the top roller of which consists of a central iron rod surrounded by a cylinder of resilient material. The space between the core and the hollow rubber cylinder is filled with liquid to exert elastic pressure, allowing knots to pass without damage.

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Editor of Proceedings: Carl Z Draves, 30 Lahey St, New Hyde Park, N Y

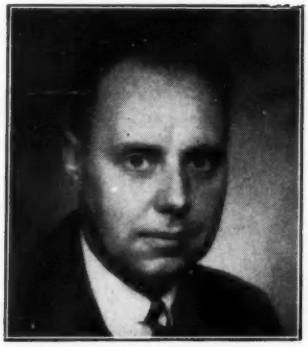
DECEMBER 22, 1952

BONNAR ELECTED TO PRESIDENCY

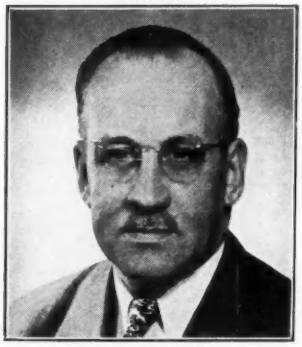
Linberg, Etchells, Hayes, Brainerd V-P's

J ROBERT BONNAR, General Dyestuff Corporation, has been elected President of the Association for 1953 according to the tellers' count of the mail ballot. George O Linberg, Synthron, Inc, has been elected Vice President of the New England Region and Arthur W Etchells, Hellwig Dyeing Corp, Samuel L Hayes, Ciba Company, Inc, and Arthur T Brainerd, Ciba Company, Inc, have been re-elected Vice Presidents of the Central Atlantic, Southern and Western Regions respectively. Over fifty percent of those eligible took part in the voting compared to about one-third in previous elections.

Mr Bonnar was graduated in chemical engineering from M I T in 1927 at which time he joined the American Finishing Company in Fall River, Mass, serving successively as chemist, chief chemist, assistant superintendent, superintendent and technical director. In 1935 he became associated with General Dyestuff Corporation as technical director which position he still holds. His past AATCC activities include the following: member of General Research Committee since 1933, chairman from 1947 to 1950; member of Executive Committee on Research since formation in 1943, chairman from 1947 to 1950; member of President's Advisory Committee since 1948, chairman in 1951; councilor representing New York Section; national vice president in 1951; member of the Colour Index Committee and its steering committee; member of Intersectional Contest Committee; represented AATCC at the I S O Conference in England in 1948; member of the following committees: Insect Pests (chairman 1940 to 1943), Transference of Color (chairman 1940 to 1943), Atmospheric Fading, Standardization for Interpretation, Cooperation with Federal Government on Uniform Fabrics, Fastness to Washing of Dyed Fabrics, Aging of Sulfur-Dyed Textiles, Mildew Proofing, Technical Supplies, Membership, Liaison with ASTM, and Liaison with ASA.



J Robert Bonnar
President



George O Linberg
Vice President (New England)

His current AATCC activities includes membership on the following committees: General Research Committee, Executive Committee on Research, President's Advisory Committee, Colour Index Committee and i:s Steering Committee, Intersectional Contest Committee, Coordination of Research Committee's Duties (Chairman), Liaison with ASTM and Liaison with ASA.

Mr Linberg is Vice President and New England Sales Manager of Synthron, Inc and was previously associated with the Du Pont Company and Monsanto Chemical Co. His past AATCC activities include

Arthur W Etchells
Vice President (Central Atlantic)

Samuel L Hayes
Vice President (Southern)

Arthur T Brainerd
Vice President (Western)

the following: treasurer, NNE Section; chairman, NNE Section; councilor representing NNE Section; national vice president, 1950 and 1951; chairman, Committee on Membership and Local Sections; chairman, Corporate Membership Committee, and General Chairman, Convention of 1946. He was also General Chairman of the 1952 Convention and is a member of the Committee on Conventions.

Mr Etchells is a graduate in chemical engineering of Drexel Institute of Technology and in textile chemistry and dyeing of Philadelphia Textile Institute. Since 1925 he has been with Hellwig Dyeing Corporation as chemist, superintendent of dyeing and technical director, successively. His past AATCC interests include the following: chairman, Philadelphia Section Intersectional Contest Committee, 1944; chairman, Philadelphia Section, 1945; councilor representing Philadelphia Section, 1946 to 1948; chairman, Philadelphia Section Advisory Research Committee; chairman, Committee on Damage Caused by Retained Chlorine; chairman, National Technical Program Committee, 1949; and national vice president, 1950. Currently he is again serving as vice president of the Central Atlantic Region and is a member of the following committees; Committee on Membership and Local Sections, President's Advisory Committee, and the Philadelphia Section Intersectional Contest Committee.

Mr Brainerd was graduated in textile chemistry and dyeing from Lowell Textile Institute in 1909. From 1909 to 1925 he was associated with H A Metz & Co, in 1926 with General Dyestuff Corporation, and since 1927 with Ciba Company, Inc, successively as technician, salesman and branch manager. His past AATCC activities included the following: chairman, vice chairman and treasurer of Mid-West Section; chairman, 1933 Convention Committee; and councilor representing the Mid-West Section. Currently he is national vice president for the Western Region, and a member of the President's Advisory Committee and the Committee on Membership and Local Sections.

Mr Hayes is a graduate in chemistry from the Virginia Military Institute, 1909, and M I T, 1911. From 1911 to 1932 he was engaged in the textile industry in dyeing, bleaching, printing and finishing as a chemist, dyer, bleacher, superintendent and manager. Since 1932 he has been with Ciba Company, Inc as manager of the Greenville, S C, office to 1936 and as southern manager from 1936 to date. His past AATCC activities include the following: chairman, New York Section; chairman, Piedmont Section; councilor, representing Piedmont Section; member, General Research Committee and Executive Committee on Research; and general chairman, 1941 National Convention. In addition to being national vice president for the Southern Region, he is chairman of the President's Advisory Committee, and a member of the General Research Committee, Committee on Conventions, and Committee on Membership and Local Sections.

CALENDAR

AATCC

COUNCIL
Jan 16, 1953; April 17, 1953; June 5, 1953.

GENERAL RESEARCH COMMITTEE
(See Council dates)

NATIONAL CONVENTIONS
September 17-19, 1953 (Hotel Conrad Hilton, Chicago); 1954 (Atlanta, Ga); Sept 21-23, 1955 (Chalfonte-Haddon Hall, Atlantic City, N J).

HUDSON-MOHAWK SECTION
February 6, March 20, May 8 (Albany); June 19 (Outing).

MID-WEST SECTION
February 14 (Hotel Bismarck, Chicago, Ill); April 18 (Netherland Plaza, Cincinnati, O); June 20 (Outing, Lake Delavan, Wis); November 7, 1953 (Hotel Bismarck).

NEW YORK SECTION
January 30, February 27 (Hotel Statler, New York, N Y); April 17, May 22 (Swiss Chalet).

NORTHERN NEW ENGLAND SECTION
Jan 9 (Hotel Vendome, Boston); Mar 6 (MIT Faculty House, Cambridge); April 17 (Lowell Textile Inst, Lowell); May 15 (Andover CC, Andover); June 12 (Annual Outing); Nov 6 (LTI); Dec 4 (MIT Faculty House).

PACIFIC SOUTHWEST SECTION
Jan 16 (Mona Lisa Restaurant, Los Angeles); April 24 (Nikabob Cafe, Los Angeles).

PHILADELPHIA SECTION
Jan 16 (Kugler's Restaurant).

PIEDMONT SECTION
Jan 10 (Clemson House, Clemson, S C); April 11, (Robert E Lee Hotel, Winston-Salem, N C); June 12-13 (Mayview Manor, Blowing Rock, N C); Sept 12 (Hotel Charlotte, Charlotte, N C).

WASHINGTON SECTION
Jan 9 (Washington, D C)—Organizational Meeting.

WESTERN NEW ENGLAND SECTION
Jan 30, Mar 20 (Rapp's Restaurant, Shelton, Conn); May 8 (Ladies Night); June 19 (Outing); Oct 2, Nov 6 and Dec 11 (Rapp's).

OTHER EVENTS

AMERICAN ASSOCIATION OF TEXTILE TECHNOLOGISTS
2nd Annual Symposium, Feb 3, Hotel Statler, New York.

AMERICAN SOCIETY FOR TESTING MATERIALS
1953 Annual Meeting, June 29-July 3, Chalfonte-Haddon Hall, Atlantic City, N J.

AMERICAN TEXTILE MACHINERY ASSOCIATION
Exhibit of American Textile Machinery, April 26-May 1, 1954, Atlantic City Exhibition Hall Atlantic City, N J.

CANADIAN ASSOCIATION OF TEXTILE COLOURISTS AND CHEMISTS (Quebec Section)
Jan 17, Feb 21, Mar 21 (Physical Science Centre, McGill Univ, Montreal, Que); April 17-18 (Annual Meeting, Mount Royal Hotel, Montreal, Que); June 20 (Annual Golf Tournament).

GLYCERINE PRODUCERS' ASSOCIATION
Convention, Jan 27, 1953

NATIONAL ASSOCIATION OF HOSIERY MANUFACTURERS
41st Knitting Arts Exhibition, April 27-May 1, 1953, Atlantic City Auditorium, Atlantic City, N J.

NATIONAL COTTON COUNCIL
4th Annual Cotton Research Clinic, Feb 18-20, Oglethorpe Hotel, Savannah, Ga.

NEW YORK BOARD OF TRADE (DCAT)
27th Annual Drug, Chemical and Allied Trades Dinner, March 5 (1953), Waldorf-Astoria, New York, N Y.

SYNTHETIC ORGANIC CHEMICAL MANUFACTURERS ASSOCIATION OF THE UNITED STATES
Jan 14, Feb 11, March 11—all at the Hotel Commodore, New York; June 11-13 (Joint Outing with Manufacturing Chemists' Association at The Greenbrier, White Sulfur Springs, W Va.

EMPLOYMENT REGISTER

This column is open for two insertions per year, per member, without charge. Blanks can be obtained from, and filed with, the Secretary of the Association, Lowell Textile Institute, Lowell, Mass. It is understood that these will be open to inspection by prospective employers who can obtain further information from the Secretary.

52-42

Education: B S in Textile Engineering, specializing in Design and Styling.
Experience: Textile Technologist, fabric development.
Age: 28; married; veteran; references; vicinity of New York City preferred.
12-22

52-69

Education: Textile Manufacturing at New Bedford Textile Institute, with course in Textile Testing and Microscopy at M I T.
Experience: Lieut, U S N, inspection and textile development; manager and designer.
Age: 46; married; references; North Atlantic coast preferred.
12-22

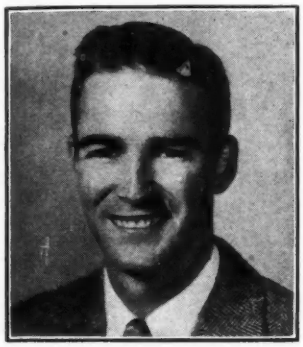
PSW Section Meeting Dates

The following dates and meeting places have been selected by the Executive Committee of the Pacific Southwest Section for the first half of 1953:

January 16—Mona Lisa Restaurant, Los Angeles, Calif

April 24—Nikabob Cafe, Los Angeles, Calif

SECOND A D R AWARD PRESENTED TO LYLE, IANNARONE AND THOMAS



C G Lyle

J J Iannarone

R J Thomas

RECIPIENTS of the second annual AMERICAN DYESTUFF REPORTER Award are Charles G Lyle, Joseph J Iannarone, Jr and Dr Robert J Thomas for their paper "High-Temperature Dyeing of New Synthetic Fibers" which appeared on page P585 of the September 17, 1951 issue. The paper was presented by Dr Thomas before the Rhode Island Section in Providence on May 25, 1951. Announcement of the Award was made by Prof Percival Theel, Chairman of the AATCC Publications Committee, at the Annual Banquet in Boston, Mass on December 8th, 1952. Judges for the Award were Harold M Chase, Consultant, *Chairman;* Ethel L Phelps, School of Home Economics, University of Minnesota; and John N Dalton, Worsted Division, Pacific Mills.

Dr Thomas was born in Lowell, Mass in 1912 and was educated in the public schools of that city. In 1934 he received his BTC degree from Lowell Textile Institute. Subsequently he was employed as a textile chemist at the Apponaug Company in Apponaug, R I. In 1936 he entered the graduate school of the University of Notre Dame where he majored in organic chemistry. In 1937 he was awarded an MS degree and in 1939 received his PhD. He joined Du Pont in the Fall of 1939, being employed in the Technical Laboratory as a research chemist. During the war years he was engaged in organic research on elastomers and other organic products in Jackson Laboratory and for a period was a production supervisor on a Manhattan Project. Since 1944 his research has been on dye application with particular emphasis in regard to new synthetic fibers. Since June, 1950 he has been head of the Technical Laboratory's Dyeing Development Division. Dr Thomas is married and the father of three children.

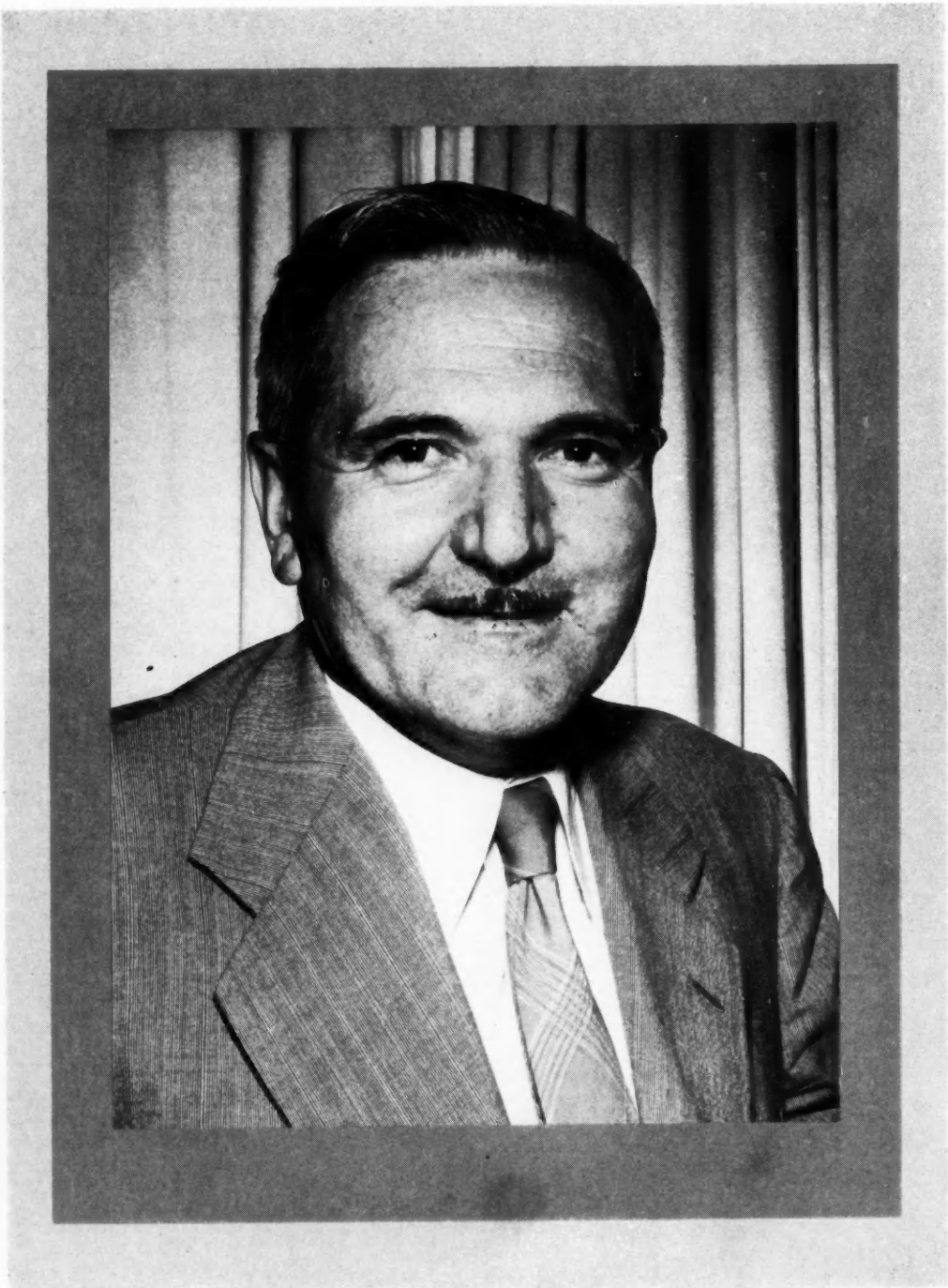
Mr Iannarone was born in Philadelphia in 1925 and in 1933 his family moved to Penns Grove, N J where he completed his elementary and high school education. In 1943 he was employed by the Du Pont company as a laboratory assistant and remained in this capacity until 1946 when he entered Temple University. He received his BA in 1949 and returned to Du Pont as a trainee in the field of dye application. In February, 1951 he was transferred to the Dyeing Development Division and engaged in development of methods of dye application to Orlon acrylic fiber and Dacron polyester fiber with particular emphasis on high temperature dyeing. Mr Iannarone is married and has one child.

Mr Lyle is 29 years old and was born in Griffin, Ga. He attended North Georgia College in Dahlonega, Georgia from 1940 to 1942 at which time he entered the service of the Army, receiving his discharge in 1945. He later studied at Georgia Institute of Technology and received his BS in 1949. He was employed by Du Pont as a chemist in the Technical Laboratory from January of 1949 until July of 1951. He is presently employed by the Graniteville Company of Graniteville, S C as Assistant Director of Research. Mr Lyle is married and has two children.

The AMERICAN DYESTUFF REPORTER Award was endowed by the Howes Publishing Company as a memorial to Alfred P Howes, Founder of the ADR. Its purpose is to encourage the presentation of the best possible papers before local and national meetings of the Association. The Award, $200 annually, is presented to the author or authors of the paper considered best in the opinion of the judges. Any technical paper presented before a local or national meeting of the AATCC and published in the *Proceedings* as they appear in the AMERICAN DYESTUFF REPORTER is eligible with the following exceptions: Intersectional Contest papers, papers by employees of the AATCC, reports of work substantially subsidized by AATCC, or reports of research committees.

It is a condition of eligibility that the paper have its first publication in the *Proceedings.* Papers published in the *Proceedings* from July 1st of one year to June 30th of the next year are considered in each judging period.

The Chairman of the Publications Committee appoints a committee of 3, other than members of the Publications Committee and representing diversified textile interests to select the winning paper.



WERNER VON BERGEN
1952 OLNEY MEDALIST

1952 Annual Convention——

NINTH OLNEY MEDAL AWARDED TO WERNER VON BERGEN

THE annual award of the Olney Medal (the ninth counting the first to Louis Olney himself) was made to Werner von Bergen of the Forstmann Woolen Co on Friday, Nov 7, 1952, during the 1952 Annual AATCC Convention in Boston. The presentation this year, the first to a practising mill chemist in the wool industry, was held at a special luncheon devoted wholly to the purposes of the award.

After eulogies of the medalist as a man and as a scientist by Giles E Hopkins and J H Dillon, respectively, formal presentation of the medal was made by AATCC President C Norris Rabold, who reminded the audience that the award of an Olney Medal had been conceived, founded and endowed by A P Howes of the Howes Publishing Co.

The texts of the eulogies and the address of the Olney Medalist in reply to the award follow.

WERNER VON BERGEN THE MEDALIST— THE MAN

Giles E Hopkins
Technical Director, The Wool Bureau, Inc

THERE are few in the textile industry who do not have some familiarity with the scientific accomplishments of Werner von Bergen. These accomplishments are so extensive and have been offered with such self-effacement and modesty that Werner von Bergen, the scientist, is much more widely known than Werner von Bergen, the man. It is therefore an especial honor to present here a glimpse of the personality behind the scientist. His originality and colorfulness provide fertile fields for harvesting, and the product of that harvest will be an inspiration for the generations to come.

Werner von Bergen was born in Oberwil-Bueren, Switzerland, in 1897. He grew up in Bern, where he attended the Public and High School. Although at one time he entertained ambitions of becoming an electrical engineer, he finally decided upon a career in chemistry. This decision was indeed a fortunate one for the wool industry. He received his diploma as a chemist from the Technical College in Burgdorf, Switzerland, in 1916, and then served a year in the Swiss Army during World War I, entering as a private and leaving as a lieutenant.

In 1917 he began work as a chemist with the Textile Printing Mills in Suhr, where he recalls that his first assignment was pasting swatches in a sample book. Such an occupation had definite limitations in the satisfaction it provided to a mind as active and inquiring as his. In fact, it was one of the two activities which he still recalls with considerable distaste. The other was an assignment to stand by the mill gate and report employees who came in late—a situation from which he immediately extricated himself by a prompt and emphatic request for transfer.

In 1918 Werner von Bergen became a chemist at the Governmental Gas Laboratory in Zurich, and a year later accepted the position as chemist with the woolen mill of Pfenninger and Company in Waedenswil, Switzerland. He remained there until 1926 except for one year, 1922-23, when he worked as dyestuff technician at the I G Farbwerke of Bayer and Company, Leverkusen, Germany.

He married Marie Diggelman in Switzerland in 1923. While on a vacation job during a college year, he had worked for a surveyor of the Swiss government. One morning, as he was preparing to climb a 4000-foot mountain in the Canton of Zurich, he met this young lady and it was love at first sight. Werner claims that one reason for the success of this marriage is that Mrs von Bergen is from the Canton of Zurich, where people are known to be quick, and he is from Bern, where people are known to be slow. This combination has worked to the benefit of both. Whenever Werner needed to be pushed, she was there to prod him and, on the other hand, whenever Mrs von Bergen needed slowing down, he was there to do it. The writer does not particularly recall incidences when a push was necessary, but this is the way Werner tells it.

They have three children and two granddaughters, the latter being children of his elder son, who is now a chemical engineer. A second son, named after his father, is still in school. His married daughter, Mrs Gerald Crossman, is presently a dietitian at Providence Bible Institute.

Werner von Bergen's life has been dominated by three ruling influences: an inquiring mind, a natural ability and desire to impart his knowledge to others, and a devotion to his church. Throughout his life he has allowed nothing to interfere with the application of any of these fundamental drives.

He claims he has been fortunate in that all of his associates and employers have been anxious to impart to him all of the practical knowledge they possessed. Possibly this may be a fortuitous combination of circumstances, but it seems much more likely that Werner von Bergen inspired such co-operation by his own attitude. At any rate, he has personally accepted the principle that knowledge is to be shared, and he is impatient with any opposing practice.

In discussing his early jobs he recalls watching the process of steaming printed pieces for three months before he was allowed to take charge of the operation himself. In the same plant the technical director had charge of the boiler room. The mysteries of feed-water treatment fascinated him, so he jockeyed himself into the job of fireman, taking over the boiler room by shoveling coal and feeding the boiler when the stoker was called to war in 1917.

One of the most important decisions in the lives of the von Bergens was the one to emigrate from Switzerland and come to the United States in 1926. Here, as always, Mrs von Bergen's thoughts were "Where you go, I shall go". After Werner's arrival in the United States, what he had learned years before in that little power plant in Switzerland served him well. The great powerhouse of the Forstmann Woolen Company bore little resemblance to the boiler room where he shoveled coal in Suhr, but he knew considerable about the chemistry of feed-water treatment.

However, there was one thing about United States' boiler-house practice that bothered him. Listening to the power-house men talk he gathered the idea that in the United States they added glue to the water in the course of the treating

process. This, of course, seemed odd indeed to the young man recently transplanted from across the ocean. Yet his sharp ears picked up the same "information" from many sources. He had not quite reached the point of making any large-scale experiments when the root of his misunderstanding dawned on him.

Many of the Forstmann employees were, like himself, recent arrivals from abroad. Their conversation included an odd mixture of English and German. How was Werner to know that, when they used the word "lime", they meant the English term for calcium hydrate and not the German word "leim" meaning glue.

The textile industry in the United States, like that abroad, did not, in 1926, lean heavily on technical controls. And yet the Forstmann Woolen Company was dedicated to the maintenance of high quality standards, but at production volumes unknown in the old country. Obviously, this combination of high production and high quality encouraged new methods of control and new knowledge of the processes to make such control possible. The production men were in a spot, and they soon found that they had in their organization a man who, while ready to listen to all they had to teach him, had an insatiable curiosity about what was behind their practical observations. One by one the mill operators accepted this new ally and called upon him. As he helped them in their problems, he learned. And what he learned he was anxious to impart to others.

First, he began to instruct the operators and the foreman at their machines as he helped them out of immediate problems. Later, the instruction became more formalized with his laboratory as a classroom. He studied aids to education and characteristically applied what he learned by extensive use of models, photographs, and finally motion pictures. He spent his vacations photographing sheep of the various types, and rarer animals, which bore fibers that could be spun and woven —the llama, the alpaca, the Kashmir goat, and the vicuna. If he could not locate the creature in its native habitat, he photographed it in a zoo holding that photograph until he could obtain a more natural pose on his travels. He spent vacations visiting experiment stations in the United States and in the mountains abroad.

Although in the early days of his career there were few facilities for wool scientists to get together—there was no Fiber Society, no Gordon Research Conference—word got around that there was a man who had delved into the secrets of wool a little more thoroughly than other people and his name was Werner von Bergen. He was sought out by individuals and by groups who were studying the fibers and the problems of their utilization. They found him at all times cooperative, patient and, possibly because of his inheritance from his father, who was a teacher, endowed with a rare ability to transmit what he knew. Soon he was teaching evenings at Columbia University, and all the time he was publishing.

To carry on such a pioneering program of raising the technical level of the industry without neglecting his responsibilities within his own organization required considerable stamina. Here again his early training and habits served him well. Born in a country of mountains he enjoyed climbing, hiking, and all forms of out-of-door sports. He could see the lake from his laboratory at Waedenswil and loved to swim. In fact, it is rumored that, lacking lake facilities, he has been known to swim in the brine tanks of the zeolite system. He also had a regular practice of skulling in summer, and in the winter took long cross-country runs clad only in trunks and jersey when the temperature was far below freezing.

In 1932 the von Bergens became citizens of the United States. They have a great love for their adopted homeland and always speak of their citizenship as a great privilege. Werner felt that the greatest tribute he could offer to his native land was to serve his new country with the qualities for which the Swiss have always been known—their love of freedom, liberty, honesty and search for the betterment of humanity. His inspiration was to try, in however small a measure, to emulate two of the greatest Swiss Americans: Albert Gallatin, the statesman who was Secretary of the United States Treasury from 1801 to 1813, and Louis John Rudolph Agassiz, the Swiss naturalist and teacher in America.

As the Swiss government was modeled after the United States government in 1848, it was very easy for the von Bergens to feel at ease. They had been brought up in the same atmosphere, and, in the course of time, when they learned to know the Rocky Mountains, their love was complete. Give the Swiss an opportunity for mountain climbing and they are "at home".

He served the Army of his adopted country as a member of that famous five-man team sent to Germany by the Quartermaster in the summer of 1945 to survey the technical developments of the woolen and worsted industry. He looked on this contribution as a symbol of his complete acceptance of the responsibilities of a citizen.

Werner and his family are active members of the Brookdale Baptist Church, where he has served several years as Trustee. He is a regular attendant at the Passaic YMCA and swims and plays volleyball with men far his junior. His vacations are still built around mountain climbing and hiking, always accompanied by his family and occasionally by his father, who exchanges visits with him frequently. On these trips he will be found loaded down with photographic equipment, which would make many younger men give thought to the extra burden involved. Some visitors to his laboratory have received an extra unexpected dividend by being invited to his new home in the New Jersey hills to see color photographs and movies taken on these trips to the mountains both here and abroad with his family.

Such opportunities are rewarding indeed, as to enter the von Bergen home is to enter a household where family devotion and a deeply religious influence spread a heartwarming assurance in this day of diminishing interest in family life. Through the years of the development of three growing children and now, with a son and a daughter in homes of their own and the parents and youngest son installed in the new ranch house which he a Mrs von Bergen planned so lovingly. this home has been a symbol of good and honest living uncomplicated by ostentation or superficiality.

Through all of his accomplishments Werner von Bergen has been a man distinguished by strength of character, steadfastness of purpose, modesty in carriage, and patience in human relations; he is a man constantly inquiring, skillfully teaching, and always constructive. A churchman, a scientist, and a true humanitarian. he asks only of those whom he has helped that "When you too have a chance to do someone a good turn, you will repay me by carrying it out".

WERNER VON BERGEN THE MEDALIST— THE SCIENTIST

J H Dillon
Director, Textile Research Institute

APPRAISAL of Werner von Bergen. the scientist, without reference to von Bergen, the man, I have found to be a very difficult task. The extent of his ability and the breadth and magnitude of his scientific accomplishments indeed provide ample material for discussion of von Bergen, scientist. Yet, weaving through the fabric of his scientific career are the strong unmistakable threads of character, kindly humanity, humor, and sincere dedication, which are inseparably

Two Views of the Medalist, the Scientist

related to his professional achievements. Thus, while I shall do my best to confine my remarks to von Bergen, scientist, I shall assume that none of you will mind if occasionally von Bergen, the man, becomes a part of the picture.

Mr Hopkins has already told you of Werner von Bergen's early training and experience in Switzerland; how he joined the staff of the Forstmann Woolen Company in 1926 and became its respected Director of Research and Control, the position which he holds today. While his training was strictly that of a chemist, examination of his many publications reveals that his contributions have extended also into the fields of physics and biology. Now as always, his central interest is the wool fiber, its processing, and products made from it. He possesses unbounded enthusiasm for wool as a textile fiber; yet, he maintains a calm objectivity, which comes with advanced knowledge of all fibers, natural and man-made. Recognized by textile research men the world over for his pioneering studies of wool, he enjoys an enviable position of esteem and appreciation within the Forstmann Company, from top management down to production workers in the mill and dyehouse. Anyone who has had the pleasure of visiting the beautifully equipped Forstmann laboratory and of discussing its sound research and development program with Mr von Bergen's able staff will understand the reason for his recognition by his own organization.

Mr von Bergen is the author of over fifty scientific papers and books, but only a few need be mentioned in order to give some idea of his many fields of interest. The first paper of which he is recorded as author was published in 1923, three years before he came to the United States. It appeared in *Melliand Textilberichte* and was entitled, "Die Wollspitzen und ihr Verhalten in der Faerberei". His first paper on the effects of sunlight on wool was published in that same journal in 1925. His interest in all animal fibers is revealed by papers on cashmere, vicuna, musk-ox wool, and even ostrich feathers. Mr von Bergen's valuable work on microscopic methods for the study of wool has resulted in a number of papers, beginning in 1932. Perhaps his best-known publications are the "American Wool Handbook" by von Bergen and Mauersberger, the "Textile Fiber Atlas" by von Bergen and Krauss, and several excellent chapters in Matthew's "Textile Fibers". Other fields covered in his papers are wool lubricants, scouring, mothproofing, processing damage, and control methods. His most recent scientific paper—"Properties of Apparel Wools I"—was published in 1952 in *Textile Research Journal* with James H Wakelin. This is only the first of some fifteen papers, several of which will bear his name, scheduled for publication on the work of the international Wool Research Project conducted co-operatively by Textile Research Institute and the Forstmann Woolen Company. Hence, Mr von Bergen continues into the future his productive career as an author—there is no stopping the man!

Mr von Bergen has been exceedingly active in the affairs of technical societies. He is now a member of the AATCC General Research Committee and has made many contributions to the standardization of wool testing methods through his long association with Committee D-13 of ASTM. He is currently chairman of Subcommittee A-3 on Wool and Its Products. He was honored in 1949 by the presentation of a scroll commemorating his work since 1932 with ASTM.

Respect for von Bergen is not confined to the American continent or his native Switzerland; his work is known throughout textile circles of Europe, and he is a Fellow of The Textile Institute of Manchester.

During the past war, Mr von Bergen was called upon many times by the military and gave unstintingly of his knowledge and energy in the effort to provide our troops with satisfactory uniform fabrics. The Office of the Quartermaster General requested the loan of his services in 1945 to undertake a survey of technical developments in the woolen and worsted industries of Germany during the war, and he became a member of the team of experts that visited Germany in the summer of that year. Those who are familiar with the reports of this textile team understand what a valuable job he did on this important mission. Mr von Bergen

continues to be a valued mentor on wool for the military departments; at present he is a member of the Advisory Board on Quartermaster Research and Development of the National Research Council.

Mr von Bergen's interests in wool extend into the realm of sheep raising and wool growing. He is extremely well informed in this field and has worked closely with government agencies and wool growers' organizations in their programs of developing better wool-type sheep and methods of evaluating grease wools. He has served for several years as a member of the United States Department of Agriculture Wool Advisory Committee.

Reverting momentarily to von Bergen, the man, his interest in sheep is so intense that he sometimes seems able to converse with them in a common silent language, which only Werner and the sheep understand. On my first visit with him to the sheep country of California, it seemed to me that the sheep had heard of his arrival and were anxious to have a look at him. He has several beautiful photographs taken during that trip, showing flocks of sheep peering shyly at us over the crest of a hill with an interest which, to the uninitiated, was easily attributable to the presence of the visiting wool expert. One of his friends relates the pleasant story of a visit to a government experiment station on a cold March day. A number of very young lambs were wandering about in the bleak wind and Werner was heard to say, "Isn't it a good thing that these little lambs are wearing wool—think how cold they'd be if their coats were of rayon!"

With all his practical knowledge of wool technology and manufacturing, Mr von Bergen has a keen appreciation of the value of fundamental research studies. He has long served on the General Research Advisory Committee of TRI and played a key role in setting up and programming the international Wool Research Project. This program, supported by wool manufacturers, government agencies and wool growers' organizations both here and abroad, has been remarkable in that it has employed a close coupling of controlled mill experiments, carried out under Mr von Bergen's direction by the Forstmann Woolen Company, with studies in the Institute laboratories. Whatever may result from this work will be largely attributable to his foresight and ability. It has been a delightful and stimulating experience to be closely associated with Werner von Bergen in this program where all his talents as a scientist, mill expert, and teacher have been brought into full play. Again and again von Bergen, the man, has appeared on the scene to carry us through rough periods with his limitless enthusiasm and indomitable spirit. He is "Dr Wool" to the Institute staff, a title which we feel should be reserved solely for him.

In the twelfth century there lived in Persia another pioneering scientist, Omar Khayyam. His accomplishments in astronomy, particularly his establishment of a calendar correct to within 19.45 seconds in the year, were truly amazing. He originally was a tentmaker, and his tents were of wool and camel hair. Certainly his delights in drinking wine and baiting religious leaders are not shared by Werner von Bergen, a temperate and devout man. Yet, there is a strong parallel between the two men in their dedication to pursuit of knowledge in their respective fields, so little explored before their times. Werner von Bergen's many scientific papers will forever record his great contributions to the science and technology of wool. Only fragmentary information, however, remains of Omar's scientific works, but he did leave behind the beautiful verses which, in Fitzgerald's paraphraseology, became the Rubaiyat. Two of these famous verses, admittedly lifted bodily from context, seem fitting for quotation at the close of this discourse on Werner von Bergen, master wool scientist—

"Would you that spangle of Existence spend
About THE SECRET—quick about it, Friend!
A Hair perhaps divides the False and True—
And upon what, prithee, may life depend?
A Hair perhaps divides the False and True;
Yes: and a single Alif were the clue—
Could you but find it—to the Treasure-House,
And peradventure to The Master too;"

THE TEXTILE CHEMIST AND HIS KEYS*

WERNER VON BERGEN

MR PRESIDENT, Olney-Medal Committee, Members and Guests of the American Association of Textile Chemists and Colorists: I accept this medal gratefully, realizing fully the honor which is bestowed upon me. With this medal in my possession I have an ever-living memorial of the man for whom the medal is named.

My first meeting with Professor Olney was at the Lowell Textile School during the late 20's. While guiding me through the chemistry department he proudly showed me his large collection of foreign and domestic dyestuffs. It was his keen foresight in gathering this collection of dyes which provided the infant American dyestuff industry with the necessary research material during the First World War. Needless to say, I was impressed with Professor Olney right from the start.

Then too, in accepting this medal, my whole family is being honored with me, as well as my cherished native land. My beloved adopted country has made this honor to me possible. The honor is also shared by my small college, the Technical College of Burgsdorf, and by the Forstmann Woolen Company.

At this time I wish to thank my many friends both near and far who have expressed their happiness in this honor to me.

To you, Giles, may I say that I was very happy that you were chosen to express my "weaknesses"; and to you Jack, I am more than pleased that you were chosen to talk about my so-called "strength." Your share in this momentous occasion has added greatly to my happiness, and I sincerely thank you both.

I am aware that, with such an honor, also a greater responsibility has been added to me in my relationships with my fellowmen. Today's occasion marks a stopping place in my own life. There are times when the impact of certain happenings in the life of nations as well as in the life of individuals is so great that it compels one to stop and take inventory.

When I received the letter from the Olney-Medal Committee telling me of their decision, I was simply dumbfounded. Awakening to the full significance of this letter I began looking back over the tracks I had covered. I tried to orientate myself about the position I was in at present, and

* Presented by the Olney Medalist for 1952 at the Statler Hotel in Boston on Friday, Nov 7, 1952, after a luncheon in his honor.

asked myself the question, "Where am I going in the future?"

Facing an audience like this, I see before me a similar group at the Annual Meeting of the International Chemists and Colorists Society in Zurich, Switzerland in 1925. It was the first time I addressed such a gathering. But I can assure you that it was with mixed emotions.

Then comes to my mind the first annual meeting of this society that I was able to attend. It was in 1931 here in Boston, and I was sitting in the audience just as you are now. I was very much impressed at that time, and one of the main things which I brought home from that meeting was the book of Ishihara entitled "Tests for Color Blindness." Within the two weeks following the meeting I went through our whole mill testing all people who had anything to do with color work, such as dyers, examiners and the whole designing staff. And to our great amazement we found that our chief designer was color blind; and he was the one who for years had made life miserable for the dyers, without realizing why.

During my college years, the chemistry professors strongly emphasized the three main factors governing any chemical reaction, namely, time, temperature and concentration.

I should like to call these three factors the master keys. The success of any textile chemist, in my opinion, is very closely connected with the proper use of these three master keys. As a young graduate I did not fully realize the value of this fact. It was simply part of the course and so much was poured upon us that I was not aware of their importance. But I soon awakened to their value right at the outset of my first job in Switzerland.

This job involved the steaming of discharge prints on cotton and silk fabrics. The first failure to produce a decent print was due to the time factor by not steaming long enough. Then it was found that, because of the wetness of the steam, the temperature factor was affected, the colors were bleeding into each other. And finally, it was found that the concentration of the discharge agent tremendously affected the brilliancy of the shade.

During World War I there was a considerable shortage of food in Switzerland. An appeal was made to manufacturers to provide installations for the dehydration of fruits and vegetables. My company answered this challenge, and the job was turned over to me to work out the proper curing time for dehydrating apples and pears.

When the installation was first finished, we discovered that we did not have enough heating elements to reach the necessary temperature for the proper drying of the fruit. The maximum amount of fruit which could be dehydrated was again interrelated with time and temperature factors.

Later, when working in the Swiss Government Gas Laboratory at the Technical University in Zurich, the realization of how little about chemistry I actually knew was brought home to me. If I was to master the keys I would have to devote additional time poring over books. Then for the first time I fully recognized the importance of the proper use of a library. Coming as I did from a small college, I was now working among a group of about nine chemists, all of whom either held doctor degrees or were engaged in post-graduate work toward degrees. Yet all of these men, who had much more knowledge than I, were devoting hours daily in the library digging up new information. These men became my examples.

In 1919 I secured my first position in a woolen mill. During my first interview the owner took me through the plant. Offering the position to me, he stated that there was plenty to be learned. I realized my utter ignorance of this entirely new field, for the only thing I knew was that the wool fiber was the hair of a sheep and that its main use was for warm clothing. Accepting his offer, I admitted that I knew nothing about the industry but that I was willing to learn.

It may interest you to know that my predecessor was Conrad Forster, who had resigned his position in order to leave for the United States, and that at one time he was a member of this Association.

In order to benefit from past and current research in wool technology, I inquired about the leading publications. Friends at the Geigy Company considered *Lehne's Faerberzeitung* and the *Leipziger Monatschrift* as the best of their kind in the German language. For the next two years I read one volume every month of both publications, beginning with the year 1900, if my memory serves me right.

The late Frederick Bauer, the former head dyer at Pfenninger's who was a graduate of the famous textile school in Bielitz, Czechoslovakia, was my first adviser in the purchase of leading textile chemistry and dyeing books. But more than that, he took a genuine fatherly interest in me and shared his knowledge and experience with me.

Within a year I was well acquainted with the work of such writers and scientists as Becke, Beyl, Erban, Georgievics, Haller, Heermann, Jovanovits, Kaufmann, von Kapff, Kertecz, Knecht, Lehne, Lloyd, Loebner, Rudolph, Schimke, Stirm and Ullmann. I never dreamed that within a few years I would have the privilege of meeting most of these men personally.

The most fascinating book I came across in those early years was Loebner's "Studies and Research Regarding Wool and Other Fibers", which was published in 1890. This book was Loebner's crowning achievement.

Loebner, having been a woolen manufacturer for half a century, pursued the microscopical study of the wool fiber after his retirement. His desire was to try to solve some of the apparently unsolvable problems that he had encountered as a woolen manufacturer. He was the man who first shattered the theory advanced by other research workers that in felting the wool scales hook into each other. He was also the first man to report the influence of sunlight on the wool fiber. The other man who was my example regarding microscopical work was that great master, Professor Alois Herzog. It was Professor Jovanovits, director of the Swiss Federal Materials Testing and Research Institute in St Gall, who was my first instructor in photomicroscopy. Also in this vein, I must mention Professor Robert Haller, who is still active as a contemporary writer. It was he who sponsored my talk at the International Chemists and Colorists Society in Zurich.

Later, Professor Herman Marks' book entitled "Contributions to the Knowledge of Wool and Its Manufacture", published in 1925, probably more than any other book guided me in the scientific approach to mill problems.

The first process Conrad Forster introduced me to was raw wool scouring, which was under the supervision of the mill chemist. The scouring train consisted of only three bowls and we had difficulty in producing clean wool, especially of the finer wool types. There right at the start I had full play of the three keys. I doubled the time by running the material twice through the machine. From the literature I readily found that the temperature had to be above the melting point of wool grease, which is around 104° F, and that the concentration of the two necessary chemicals, soap and soda, had to be well balanced to produce the optimum of cleanliness. One of the main tools I used to establish the concentration key was Becke's biuret reaction with caustic soda and copper sulfate.

Another vivid experience I had in the use of these three keys was in the manufacture of aluminum chloride. We used this product for carbonizing purposes. Because of the shortage of this chemical and its high price right after World War I, we started the manfacture of this product in the backyard of the mill. We used aluminum foil, cuttings and shavings, and similar waste products for our raw material, dissolving them in concentrated hydrochloric acid. The reaction was of such vigorous nature and connected with such a high temperature rise that we had to use ice for cooling purposes. Not only was this necessary to avoid the boiling over of the

liquid, but it prevented the escape of hydrochloric acid into the air and its settling down on the surrounding plants and trees, which would have led to their destruction.

During the year at the Bayer Dyestuff Works, George Rudolph, probably one of the leading wool dyers at that time, was my friend and teacher. He instructed me in the proper application of the three master keys for acid dyes, chrome dyes, and especially vat dyes.

When I came to the Forstmann Woolen Co. twenty-six years ago, I was impressed by two processes, continuous piece scouring and continuous neutralizing—stock and piece. I thought that it was impossible to scour a piece of cloth in less than two hours or to neutralize a piece of cloth in less than an hour. But here again the secret was simply in the use of the proper concentration key. In the neutralization of pieces, instead of using solutions containing one ounce per gallon, the pieces ran through a bath containing six ounces of soda per gallon. To me, at first sight, this concentration was much too dangerous for woolen goods, but, because the pieces were in this solution only a few minutes, the danger of damage was eliminated. I found the same to be true for the continuous neutralization of carbonized loose stock.

The continuous stock-neutralizing machine taught me the possibiljty of using this type of equipment for other purposes, such as continuous chlorination and even dyeing. But it was not until the late Bob Wentz came with the idea of using that type of machine for continuous indigo dyeing that I fully realized the possibility of such machines for dyeing purposes.

This continuous indigo dyeing process, about which I reported at the convention in Atlantic City, on October 14, 1944, is a classical example of the interrelation of the three master keys.

As the size of the machine had to be limited for economical reasons, the time for the wool to go through the machine was automatically limited. The short time allotted for the loose wool in the dye bowls made it necessary to increase the temperature as well as to increase the concentration of the chemicals in order to produce a fast shade. Not only was this relationship true for the three keys in the dyebath, but also we had to adjust them accordingly in the oxidation baths, rinse baths, as well as in the drying unit.

This continuous indigo process was rather slow compared with the recent developments in high-speed dyeing, such as the molten-metal process or the oil process of Williams. But in these new processes you see again that, when one key is changed, it automatically affects the other two. With the increase in the temperature to previously unknown heights, you must have a parallel increase in speed as well as a radical change in concentration.

The Olney Medal

I could go on indefinitely with further illustrations on the use of these master keys.

Now I wish to portray the attributes that a capable chemist must have to master these three keys.

The success which a man may have in his life depends on three attributes. These are devotion, enthusiasm, and energy. The devotion or the time he devotes to his work is the counterpart to the time factor, the enthusiasm a man displays for his work registers the temperature. The energy which he puts into his work is the concentration key. All three are necessary.

I should like to use a simple illustration. No doubt there are many devoted football fans right in this audience. They spend much time at the fields and in talking about the game. They demonstrate their enthusiasm by praising their teams unto high heaven and by yelling themselves hoarse when a touchdown is made. But only a few are on the field actually playing and putting their energy to work helping to win the game.

I should especially like to speak to you young chemists and students. It is not enough, if you want future success, to devote the specified number of hours at your place of work. You must be willing to devote much additional time to further study. In addition to the study of the current and past literature, you should associate yourself with professional groups. This very organization was established not only as a social one, but to help especially the younger elements to promote increase of knowledge, to encourage in any practical way research work and to establish for the members channels by which the interchange of professional knowledge among them may be increased.

In my own case, my connection with the American Association of Textile Chemists and Colorists helped me tremendously to increase my knowledge and encouraged me in the practical approach to further research. This brought about numerous contacts. Many have developed into life-long friendships. In this connection, I know that you will all bear with me, if I mention only two: Alban Eavenson and Hugh Christenson.

You must be sincerely enthusiastic about your work. Your job must fascinate you and I know that the deeper you delve into the knowledge of textile fibers the more fascinated you will be. One of the elements which is very important in selling yourself to a new employer is to show enthusiasm. However, enthusiasm is not enough. There is an old established law that you have to put energy into your work, because only then can you show by actual deeds that your devotion and your enthusiasm is real.

We veterans of the textile industry must recognize the responsibility we have by exemplifying these three attributes. Only then will we create in the minds of the young students the desire to choose our profession. We must be willing to stoop down and help, give advice and show interest in the oncoming generation.

I shall be forever grateful to all my employers who showed me their personal interest and who tried in every way possible to further my growth. It was their human interest and personal understanding which gave me the incentive to strive ahead.

In summing up, I have tried to show that the master keys provided for a textile chemist are time, temperature and concentration undergirded by proper professional knowledge. I have tried to illustrate that the successful use of these three keys depends upon three necessary attributes, which a person must possess. They are de-

votion, enthusiasm and energy for any given task.

At this time I should like to express my heartfelt thanks to my employers and friends. My thoughts and grateful appreciation go to

The late Mr Joseph Grasser, my first employer.

The late Messrs Wilhelm and Herman Pfenninger.

The late Mr Julius Forstmann.

The late Mr Curt Forstmann.

My present employers, Mr Julius Forstmann, Mr Kenneth Wilson,

and to all my colleagues, associates and coworkers.

And now, if I may—a few personal remarks:

Out of the thirty-six years during which I have been connected with the textile industry, for thirty happy years, my well-being and comfort, as well as my spiritual growth has been tended, guarded and guided by my dear wife. The main task of rearing our three children has been upon her shoulders, and that they are so lovely is entirely to her credit. I could go on and on expressing my thanks to her, but it is not necessary—for she understands.

Finally, and above all, I must follow my own dictates and publicly express my gratitude to my Heavenly Father, for without His help I would have achieved nothing.

Where am I going in the future? I cannot express it any better than to quote from Paul's letter to the Galatians, Chapter Six, Ninth Verse:

AND LET US NOT BE WEARY IN WELL DOING FOR IN DUE SEASON WE SHALL REAP IF WE FAINT NOT.

Meeting To Organize Washington Section

A MEETING to decide upon the organization of a new local section, to be known as the Washington Section, is scheduled to be held in Washington, D C, on Friday evening, January 9, 1953. This action was approved by the Council at its meeting on November 6, in response to a petition signed by more than 25 members residing in Washington and the surrounding areas of Maryland and Virginia. The Council designated Dr Walter M Scott as the Secretary *pro tem* for the purpose of calling this organization meeting.

—♦ ♦—

Annual Meeting—NNE Section

December 5, 1952
Lowell Textile Institute
Lowell, Massachusetts

THE election of officers of the Northern New England Section for 1953 was held on Friday, December 5, 1952 at the Lowell Textile Institute during the Section's Annual Meeting.

LTI President Martin J Lydon opened the meeting with an announcement that the Institute is planning for a Summer School. Prof John H Skinkle outlined the problems involved and requested guidance and suggestions from the membership.

NNE Chairman C Wendall Lever, on behalf of the Section, thanked and congratulated those on the National Convention Committee. In the absence of George O Linberg, Convention Chairman, Walter J Hamburger gave a report on its success.

Edward Chapin presented the report of the Nominating Committee. A unanimous vote for the following slate of officers was recorded:

Chairman—Ernest R Kaswell, Fabric Research Laboratories

Vice-Chairman—John M Gould, Barre Wool Combing Co, Ltd

Treasurer—William W Pennock, E I du Pont de Nemours & Co, Inc

Secretary—Azel W Mack, Dexter Chemical Corp

Councilors — Edward B Bell, Textile Aniline & Chemical Co; Elmer E Fickett, Lowell Textile Institute; Frank J O'Neil, Pacific Mills Worsted Division; Sawyer F Sylvester, Monsanto Chemical Co

Sectional Committee—Alfred J Carbone, Sandoz Chemical Works, Inc; Leslie Christison, American Woolen Co, Inc; Kenneth E Dorman, Goodall-Sanford, Inc; Robert D Robinson, Bachmann-Uxbridge Worsted Co

The fourth Councilor has been allowed due to the Section's increased membership.

The new Chairman, Mr Kaswell, introduced Robert M Greenberg, recipient of the Ralph E Hale Scholarship Fund.

Speakers of the evening were W B Coleman, Victor Chemical Works, who discussed "The Chemistry of Diammonium Phosphate" and John N Dalton, Director of Chemical Research, Pacific Mills Worsted Division, who spoke on "Practical Applications of Diammonium Phosphate in Wool Dyeing".

Meeting dates for the Section in 1953 are as follows:

Jan 9—Hotel Vendome, Boston

Mar 6—MIT Faculty House, Cambridge

Apr 17—Lowell Textile Institute, Lowell

May 15—Andover Country Club, Andover

June 12—Annual Outing

Nov 6—LTI, Lowell

Dec 4—MIT Faculty House, Cambridge

Respectfully submitted,

AZEL W MACK, *Secretary*

1952 YEAR BOOKS

The Year Book of 1952 has been mailed to all who were members in the year ending October 31, 1952. Extra copies can be purchased by members for $4.00; by others for $5.00. A member elected after October 31 is entitled to the book of 1953, but can purchase one copy of the book of 1952 at a reduced price of $3.00. Orders should be sent to the Secretary, AATCC, Box 28, Lowell, Mass.

REPRINTS OF TEST METHODS

For the convenience of those using only Part III of the 1952 Year Book, on Test Methods, reprints of this alone can be purchased from the Secretary, AATCC, Box 28, Lowell, Mass, for $1.00, postpaid.

NOTICE

Dues received in October and November have been acknowledged with membership cards, and every later payment will be acknowledged within two weeks. If you have renewed your membership but have not received your card, please notify the Secretary, AATCC, Box 28, Lowell, Mass.

1952 Annual Convention——

METHODS OF PRODUCING BONDED-FIBER FABRICS*

HOWARD E SHEARER

Textile Research Department
American Viscose Corporation

INTRODUCTION

BONDED-FIBER FABRICS, which are an evolution of glazed and bonded waddings known for the past century *(1)*, have only recently become known to a large segment of the textile industry and are as yet practically unknown as a textile to the consuming public. The slow spread of technical information on this subject may be attributed to a natural and understandable reticence on the part of those who have developed special equipment and manufacturing techniques to reveal details of their operations at such an early stage of commercial production. This, together with no unanimity of opinion among the manufacturers themselves as to how this modern fabric-like material should be referred to, or defined, and a lack of concerted effort at publicizing it as a distinguishable new material in the many products in which it is meeting wide success have done little to advance public acclaim.

These barriers are gradually being lowered through technical committee meetings *(2, 3)* which manufacturers of these materials increasingly attend, and through papers they have presented relating to their own product and method of manufacture *(4, 5, 6)*. This gradual dissemination of information has seen the production of bonded-fiber nonwoven fabric increase from around a few thousand pounds per year about ten years ago to more than 25,000,000 pounds today. (This figure does not include the heavier bonded waddings and pressed felts, which may be considered as belonging to an allied field of use.) With the new equipment being developed and the additional manufacturers entering this field, it seems a safe assumption that this new industry will double its output about every three years for the next ten or more.

It has now become well known that this material is generally produced by carding, blowing and otherwise collecting almost any desired fiber in the form of a web, which is bonded either by the activation of thermoplastic fibers that may be present as a part of the web or by the addition of adhesives in solid or liquid form. As may be expected, these various means of producing bonded-fiber fabric result in a wide range of properties and attendant uses *(7)*.

Howard E Shearer

It is shown that bonded fibrous web materials, which have now become well established under the name of Nonwoven Fabrics, may be varied in their composition and structure to give a range of physical characteristics comparable to that obtained in woven fabrics. These features are obtained through many novel arrangements of existing textile equipment as well as through the use of newly developed machines especially for the purpose, which, in a continuous process, convert the raw fiber into finished fabric. Equipment for carrying out these operations by various means is diagrammatically illustrated and described by the author in relation to its use with fibers of different descriptions, bonding media and product features.

While there has been some reference in the literature to the physical and chemical properties of the thermoplastic fiber-bonded fabrics *(8, 9)* and to methods for evaluating wear resistance *(10)*, very little has appeared concerning the range of characteristics that is available in the present commercial fabrics, or the machine arrangements for producing this material. It is the intent of this paper to show a partial range of the characteristics that have been built into some bonded fiber fabrics and various machine arrangements possible for producing an even wider range of properties in material of this type. The arrangements shown are not necessarily that of any commercial producer of this material.

PHYSICAL PROPERTIES

In Table I are presented data on seven different nonwoven fabrics from the commercial production of five manufacturers. These were selected from among eighteen fabrics tested *(11)* to illustrate the various properties that may be built into these materials through the use of different fibers, bonding agents and methods of manufacture.

Fabrics V-C and V-R differ in their manufacture only with respect to the type of fiber used. They are of an over-all-liquid-bonded type with a firm, fairly hard finish. Sample V-C, made of cotton, contained many neps; while V-R, made of rayon, was clear and uniform. Although of approximately the same weight, the rayon fabric is much thinner, stronger and of higher permeability than the cotton fabric.

Fabrics W-1165 and W-1182 are of another manufacture, employing thermoplastic fiber as the bonding agent. Sample 1182 possesses a papery hand and is marked by its extremely low air permeability and low absorbent capacity. It possesses high strength in relation to its weight and to the other fabrics tested. Sample 1165 is softer and bulkier and is characterized by very low bursting strength and great flexibility. Differences as observed between these two fabrics may be readily obtained by varying the amount of bonding fiber present or the heat and pressure applied in bonding.

Sample P-5, the heaviest of those tested, is a multiple-cotton-card-web type, over-all bonded in a mock longitudinal-rib formation with synthetic latex. It has a relatively high drape value, but is not outstanding in other properties.

The MA fabric is a rayon-cotton blend, intermittently bonded with a series of printed transverse resin stripes. It is representative of a soft, absorbent, drapable type in which breaking, bursting and

* Presented at the Hotel Statler in Boston on Nov 7, 1952.

TABLE I

PHYSICAL CHARACTERISTICS OF SOME COMMERCIAL NONWOVEN FABRICS

Sample	*V-C65D*	*V-R65D*	*W-1165*	*W-1182*	*P5-368*	*M-A103*	*L31-2830*
Weight, oz/sq yd.....	1.67	1.54	2.91	2.75	3.38	1.76	2.91
Thickness, inches at pressure of 0.1 lb/sq in...	.0151	.0088	.0121	.0076	.0124	.0173	.0101
Breaking Strength (Grab)							
Lengthwise, lb	31.5	37.5	10.5	41.0	22.5	19.5	9.5
Crosswise, lb	9.0	9.0	0.5	13.5	6.0	3.0	9.5
Tearing Strength (Trapezoid)							
Lengthwise, lb	1.0	2.0	2.0	2.0	1.0	1.0	1.5
Crosswise, lb	0.5	1.0	0.5	0.5	0.5	0.5	1.5
Bursting Strength, lb (Scott-Ball Burst)	10.0	18.0	3.5	11.5	9.0	11.0	5.5
Permeability—cu ft/min per sq ft.....	185.0	254.0	27.6	3.5	214.3	390.2	54.3
Absorbent Capacity, % (Chicopee Method)	616	593	837	109	512	966	1179
Stiffness (Gurley)							
Lengthwise, mg	235	234	68	93	95	34	45
Crosswise, mg	95	46	11	28	13	18	42
Drape, Hanging—Loop Method							
Lengthwise, inches	2.1	1.5	2.0	1.7	2.1	2.2	2.1
Crosswise, inches	1.8	1.7	3.2	2.3	3.2	2.7	2.1
Flammability (AATCC Tentative Method)							
Lengthwise, seconds	9.3*	7.1	12.1*	25.8*	7.7	8.4	11.6
Crosswise, seconds	8.6*	7.8*	12.3*	27.6*	11.2	7.2	12.0

tear strengths, thickness and stiffness increase directly with the weight of the material. This sample is characterized by an extremely high air permeability.

It will be noted that all of these fabrics are characterized by a more or less unidirectional strength, with the exception of sample L 31. This is an over-all-resin-bonded and calendered type of carded and blown isotropic-fiber-web material.

The burning time of each of these fabrics was over six seconds, which, under the method used, would class them as not dangerously flammable. Samples marked with an asterisk required two or more rapidly repeated applications of the flame for ignition.

Many more interesting comparisons may be made between these fabrics, which time does not permit us to go into.

MACHINE ARRANGEMENTS

MULTIPLE CARD LINE———In order to produce these different types of nonwoven or bonded-fiber fabrics with such a wide range of properties, new machines are being developed and used as well as many novel arrangements of existing textile equipment. One of the simplest and most widely used methods of forming the basic web structure is through an arrangement of cotton cards in series or in parallel, as shown in Figure 1. It will be seen that the web from each card is laid upon that from the preceding card in the line. The number of cards used will depend upon the weight of the composite web desired, which usually constitutes from 50 to 100 per cent of the weight of the bonded and finished fabric.

In the production of nonwoven fabric it is not unusual for each cotton card to deliver 35 pounds per hour. While this is considerably higher than is customary in producing sliver for yarn spinning purposes, this poundage may be even further increased by using a double-picker lap feed and double doffers. This arrangement would also permit use of fewer cards in the production line.

Both fillet and metallic wire are used on either revolving flat or roller-top cards. Which arrangement is used has been largely a matter of personal choice governed principally by what is most economically available to a particular mill. With the installation of new equipment purchased solely for the production of this web material, much more thought is being given to these manufacturing details.

GARNETTS AND WOOLEN CARDS ———Garnetts and woolen cards have a seeming advantage over cotton cards because they can deliver greater poundage in wider widths, and they are more versatile in that they can handle a greater variety of fiber descriptions with satisfactory uniformity and less parallelization of fibers so as to step up the transverse strength of the web. Production rates will vary with the type of fiber, weight and quality of web, and speeds. It is not unusual for woolen cards to produce webs of satisfactory quality at 150 lb per hour, while garnetts may operate at twice this rate. However, the initial machine costs run considerably higher than with cotton cards. Typical garnett set-ups equipped with a cross-web delivery apron are illustrated in Figures 2a and 2b.

If it is preferred, the wide web as produced on a garnett or woolen card may be slit at the doffer into two or more equal widths and delivered one upon the other without cross laying as a single composite narrower sheet.

CROSS LAYING ——— Possibly the most popular means of taking off the wide web from a garnett is through a cross-web-laying method similar to that shown in Figure 3. This permits delivery from a single two- or three-cylinder garnett of fiber mats ranging from two to sixteen ounces per square yard in 80" widths, and provides a means of securing a more balanced strength in both the longitudinal and transverse directions, thus overcoming what has been one of the principal criticisms of many nonwoven fabrics. The relative delivery rate of the web [A] to the speed of the conveyor [C] governs the angle of the cross lay and the weight of the mat.

In addition to the web shown being fed crosswise to the conveyor, it may be found desirable to lay in from an additional garnett a web, not shown, moving in the same direction as the conveyor, thus providing a smooth unbroken surface on the composite fabric when bonded.

In Figure 3 is also shown a means of bonding the web, when composed of a blend of potentially adhesive and nonadhesive fibers, by passing it around a heated cylinder [D] under controlled pressure supplied by the blanket [E] and adjustable rolls [F].

Nonwoven fabrics produced by this method have been characterized by more or less prominent diagonal cross streaks from overlapping portions of the web. These streaks may be quite objectionable for many uses, especially in the lighter-weight material. This deficiency was early recognized and means were developed to cross-lay, at right angles, adjacent lightweight web sections over a continuous longitudinal web *(12)*. Methods were also developed for further improving the strength of carded webs by subjecting them to a drafting operation to better align the fibers *(13)*. One of the early references in the literature to a machine incorporating the principles of both right-angle cross laying and drafting of webs was based on the work of the Draper Corp *(14)*. Such a procedure is shown in Figure 4. The supply packages [A] may be picker, ribbon or card lap, or other loose fibrous mat capable of being drawn through the rolls of the drafting heads [B] to align the fibers in relatively thin web form on the conveyor [F]. One drafting head feeds the web in the machine direction, while another lays on a secondary web at right angles to the first as its carriage moves on a track across the machine

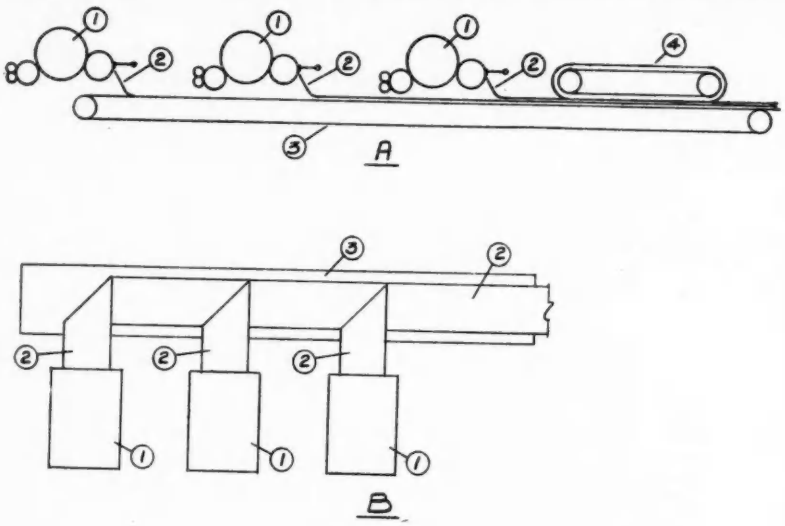


Figure 1

Multiple Card Lines for Producing Nonwoven Fabrics Showing Method in Arranging in Series (A) and in Parallel (B)

1—Card
2—Web
3—Conveyor
4—Multiple lapper for building up extra-heavy material

Figure 2a

Two-Cylinder Garnett Equipped with Cross-Lay Delivery Apron, Compression and Take-Up Rolls

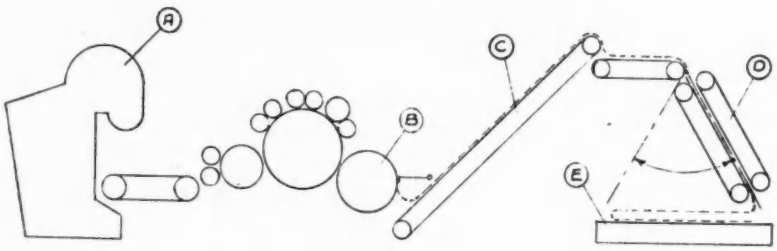


Figure 2b

Single Cylinder Equipped with Cross-Lay Delivery Apron for Production of Bonded-Fiber Fabrics

A—Hopper Feeder
B—Garnett
C—Take-off Apron
D—Lapper
E—Delivery Apron

at an angle determined by the speed of the conveyor. As this secondary supply and drafting head reaches the far side of the conveyor, the feed rolls [B] stop, while the lower rolls [C] continue to rotate and break the cross web flush with the edge of the longitudinal web. The carriage then returns to the near side of the conveyor without feeding and repeats the cycle with the leading edge of each succeeding web feathered into the edge preceding it so as to leave no visible overlap or break in the cross feed. One or more such units may be built into a separate machine or may be incorporated in the supply package-production line, so as to produce in a continuous operation a cross laminated web, which can be treated directly with a suitable bonding agent, dried and wound into rolls of nonwoven fabric possessing more woven fabric-like qualities than have heretofore been obtained.

As to a suitable bonding agent and its method of application, the nonwoven fabric manufacturer has an even wider choice than he does in the method of producing the fibrous web. With the various methods of web formation the manufacturer has the choice of thermoplastic fiber-bonding agents, such as plasticized cellulose acetate *(6, 15)* and Vinyon *(8, 16, 17)*, as well as numerous powdered or liquid adhesives, the most popular of which are PVA, cellulose xanthate, rubber latex, butadiene and vinyl-resin emulsions.

The fibrous bonding agents are an intrinsic part of the web, while the powdered and the liquid agents are subsequently applied in the production line by conventional print-roll *(18)*, padding *(19)*, dipping *(20)* and spraying *(21)* methods.

Bonding and drying are accomplished through use of calender rolls, dry cans and multiple-pass hot-air ovens, with which most of you are familiar. These operations have been dealt with in more detail in a previous paper by the author *(30)*.

AERODYNAMIC METHODS —— While drafting and cross-laying the web offers a means of producing a high-strength nonwoven fabric with equal strength in the longitudinal and transverse directions, closely approaching woven fabric in some features, it was felt by many that a random-fiber fabric with equal strength in all directions would be of advantage for many uses; for instance, as a backing for resin coatings and the reinforcement in laminated plastics. Methods of producing randomly dispersed fibrous mats by utilizing a combination of carding and air-suction-delivery principles have long been known *(22)*. More recently the Curlator Corpora-

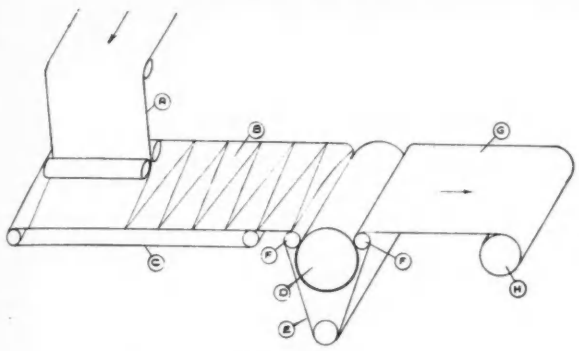


Figure 3

Cross-Laying and Bonding Method for Production of Thermoplastic Fiber Bonded Nonwoven Fabrics

A—Web from card or garnett
B—Cross laid web
C—Conveyor
D—Heated cylinder for bonding
E—Pressure blanket
F—Variable pressure rolls
G—Bonded web
H—Take-up

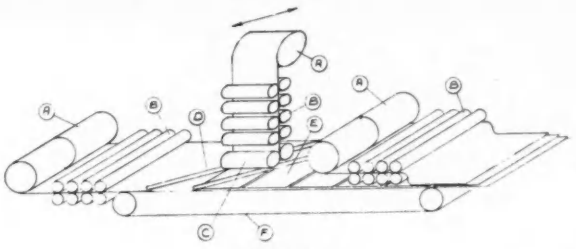


Figure 4

Method of Producing a Drawn and Cross-Laid Nonwoven Fabric

A—Laps
B—Drawing Rolls
C—Breaker Roll
D—45° Track
E—Right Angle Cross-Laid Lap
F—Conveyor

tion has designed and placed on the market a machine designed especially for the production of random-laid fiber mats said to range from around ½ to 10 ounces per square yard *(23)*. A flow diagram of this unit is shown in Figure 5.

A novel feature of the feeder of this unit is the air bridge *(4)*, by which the fiber is carried into the wedge-shaped opening in the screen box between the air screen [5] and the roller conveyor [6] by means of forced air suction, which is satisfied when the wedge is completely filled. Surplus fiber recirculates on the pin apron until the suction automatically increases with the rate of removal of the fiber at the delivery end of the wedge. Thus, a uniform heavy mat feed is always insured to the feed roll [9] of the webber.

Fibers from the tightly compressed mat from the feeder are picked out by the metallic wire teeth of the high-speed lickerin of the webber and sucked by high-velocity air through the constricted throat of the Venturi-like duct and uniformly deposited on the circular screen of the condenser as the air passes on through to be humidified and recirculated. The random-fiber web flows continuously from the condenser to the rubberized belt conveyor [14] for subsequent bonding and finishing as preferred.

It will be observed that very little opening or carding action takes place other than is provided by the pins of the feed apron and the lickerin. The quality and fineness of the web produced will therefore depend a great deal upon the type and condition of the fiber being processed. This random-web unit has been placed on the market in a 40″ width with a rated capacity of 10 to 40 lb per hour, depending on the type of fiber being run and the weight of the web being produced. It is being supplemented with a wider 80″ machine of correspondingly greater capacity and other improvements designed to handle better a wider range of the man-made fibers as well as the shorter natural and waste fibers for which it was originally designed.

What was considered by some, in the early embodiment of the Rando Webber, as a lack of sufficient carding action to open sufficiently the longer textile fibers, and inadequate control in the air distribution of such fibers by other available means, have led to further thought on ways of combining more carding action with a controlled air doff for collecting a uniform random light-weight fiber web *(24, 25)*. A means of doing this is illustrated in Figure 6, wherein the fiber from a garnett or woolen-type card [A] is

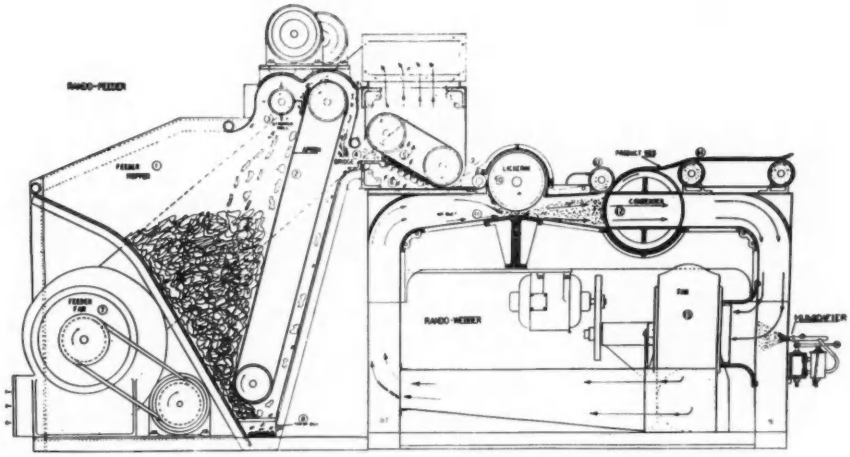


Figure 5

Diagrammatic View of the Rando Feeder Rando-Webber Unit for Producing Random-Web Material

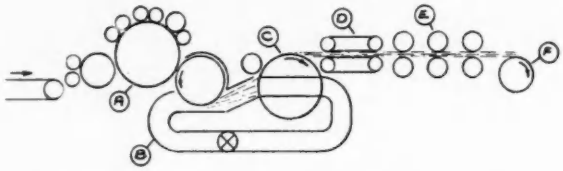


Figure 6
Method of Producing Thermoplastic Fiber-Bonded Fabric by Carding and Aerodynamic Web-Forming Principles with Hot Pressure Bonding

A—Garnett
B—Air Duct
C—Condenser
D—Compression Conveyor
E—Calender Rolls
F—Take-up

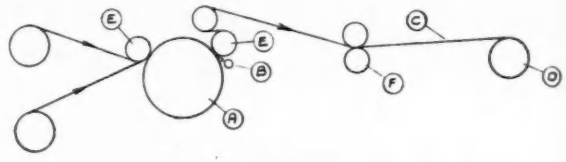


Figure 9
Method of Forming a Laminated Fabric of Different Color Face and Back

A—Heated Drum
B—Air Jet
C—Multi-ply Bonded Fiber Web
D—Wind-up Roll
E—Pressure Roll
F—Pull Roll

throat of duct [B] and uniformly deposited on the condenser [C] from which it is conveyed to suitable compression and bonding equipment.

Shown also is an arrangement for bonding the mat when thermoplastic fibers are present. The mat is initially lightly compressed at [D] preparatory to entering the calenders [E], the temperature and pressure on each set of rolls being individually controlled with maximum temperature on the intermediate set and pressure, or roll clearance, of the last set adjusted to control the final thickness of the fabric.

A number of other methods have been devised for air-processing fibers and laying up webs for producing bonded-fiber fabrics. For the most part these are designed for handling special fibers or with specific end uses in mind *(26, 27)*.

A method of utilizing short fibers to form webs aerodynamically for the production of isotropic nonwoven fabric is illustrated in Figure 7. This arrangement makes use of a fiber blower [A] of a type used in the fur-felt-hat industry, consisting of three or more sections with each section having a pair of feed rolls, lickerin and condenser cylinder. The preopened fiber from the hopper is taken by the feed rolls of the first section and freely dispersed within the confines of that section by the high speed of the lickerin and collected on the wire condenser cylinder for transfer to and similar working in each succeeding section of the blower. From the blower the well-dispersed fiber is air-borne through the forced air duct [B] to the web condenser [C] from which it is belt-conveyed to suitable bonding equipment. To assist the processing of a thermoplastic fiber content material we have shown an auxiliary spray [D] for moistening the web to provide additional temporary body, or for adding a liquid surface bonding agent. Bonding is completed by means of an intermittent operating heated flat bed press [E].

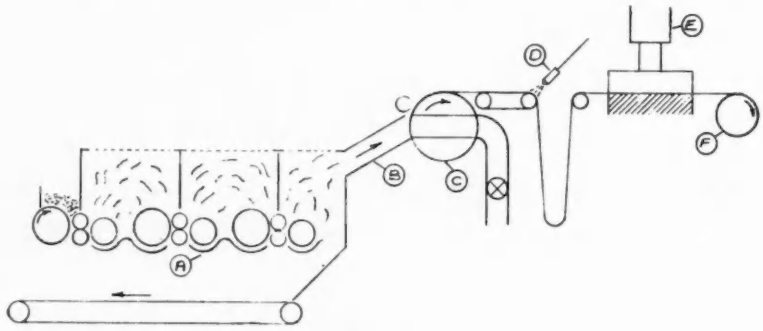


Figure 7
Method of Blowing and Bonding Fiber for Producing an Isotropic Nonwoven Fabric

A—Fiber Blower
B—Forced Air Duct
C—Condenser
D—Spray Head
E—Bonding Press
F—Take-up

DYEING AND FINISHING

DYEING REQUIREMENTS ——— While many uses for bonded-fiber fabrics do not require dyeing and finishing, there are constantly expanding numbers that do *(28)*. When dyeing is required, the character of this material would seem to call for the development of a special technique to handle it successfully. However, the very nature of this material, the manner in which it is made and the uses to which it is put make this not too difficult.

Nonwoven fabrics are mostly designed for a particular end use or for a short life cycle. Its price ranges between that of high-grade paper and medium-quality woven fabric. These conditions require and permit a relatively low-cost method of dyeing, which may frequently be accomplished in a continuous operation with the web production by incorporating the color in the bonding agent. While the fiber as well as bonding agent employed will govern the selection of a dye, direct and alcohol-soluble acetate dyes are most frequently used. In some instances there is a demand for faster colors and for stock-dyed fiber. These demands are being satisfied. Screen, block and rotogravure printing are quite common.

DYEING METHODS———A method of dyeing, setting and finishing nonwoven fabric is shown in Figure 8. This method is particularly applicable to such fabrics made of rayon and a thermoplastic bonding fiber *(6, 29)*. The fabric enters the

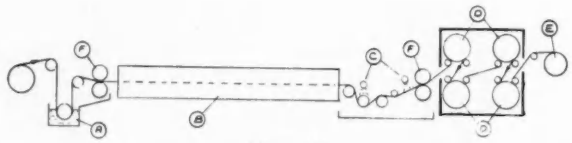


Figure 8
Dyeing, Drawing and Finishing Arrangement for Bonded Fiber Fabrics

A—Dyebath
B—Steam Drawing Oven
C—Washing
D—Perforated Drying Cylinders
E—Wind-up Roll
F—Squeeze and Tension Rolls

doffed by air suction at the constricted cool aqueous dye bath [A] containing a mixture of direct and acetate dyes, plus wetting-out agents necessary for adequate dye pick up in the short bath time. Excess liquor is removed by squeeze rolls [F] which also act as tension rolls against the drawing force of the fabric as it passes through the steam-air oven [B] maintained at about 180° F to prevent the web drying out and to set the dye on the fiber. As the web emerges from the oven it is given a rinsing and finishing spray [C]. Squeeze rolls [F] at the after end of the finishing bath are driven at a slightly faster rate than those at the dye bath thus exerting a slight drafting action with as much as 30% widthwise contraction as the web passes through the oven. This tends to align the fibers, thus increasing the strength, sheen and transverse stretch in the fabric after drying on enclosed externally air heated rolls [D]. As many as three layers of fabric are simultaneously processed by this method.

Thermoplastic-bonded-fiber fabrics dyed different colors by the method just described, or by other means, may be bonded together into a single fabric of attractively contrasting face and back colors by a procedure similar to that shown in Figure 9. By this same procedure a number of these fabrics may be laminated to secure a heavier material. The bonding together of the fabrics is controlled by the adjustable pressure of covered rolls [E] against the heated steel cylinder [A]. Careful control of temperature and pressure is necessary to prevent sticking of the fabric to the heated cylinder, while the use of mold-release agents, a baked Teflon finish or glass fabric covers on the rolls will frequently be found helpful. Use of an air jet [B] also aids in releasing the fabric. Pull rolls [F] keep the fabric under tension to prevent wrinkling while cooling.

This discussion of methods of producing bonded-fiber fabrics would not be complete without some mention of a method for producing a composite yarn-faced nonwoven fabric of a type that is receiving considerable attention. Such a method is illustrated in Figure 10, wherein it is shown that a sheet of parallel adjacent ends of yarn, sufficient in number to cover the width of material to be produced and of a type compatible with the bonding media in the nonwoven fabric material, is run from one or more section beams [A] through suitable guides [B] and tension devices [C], to where it meets with and is autogeneously bonded to the nonwoven fabric backing [D] as they simultaneously pass around the heated bonding drum [E]. The composite fabric is drawn under tension through the padder [F], where suitable dyes, usually of

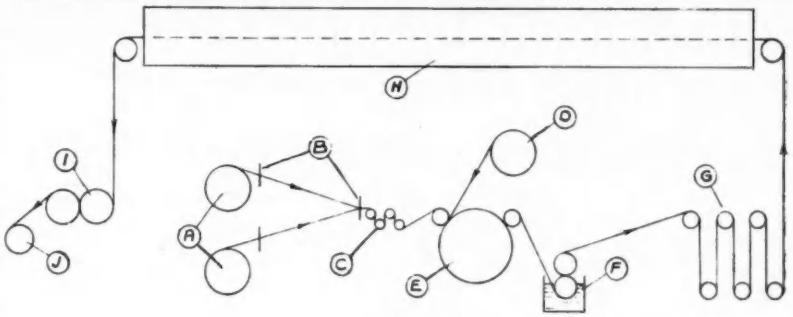


Figure 10
Method of Producing Warp-yarn Face "Sateen" Bonded-Fiber Fabrics

A—Yarn Beam
B—Reed
C—Take-up Bars
D—Bonded Web
E—Bonding Drum
F—Dyebath
G—Compensation
H—Drying Oven
I—Take-off Drum
J—Wind-up

an alcohol-soluble acetate type assisted by wetting-out agents, are applied. Insertion of a compensator [G] between padder and drying oven [H] is advisable to allow for variations in rate of delivery brought about by dimensional changes in the fabric, stoppage or other cause. Bonded fabrics of this type possess high longitudinal strength and excellent transverse tear resistance, but slit lengthwise very easily. They possess a satin-like finish which make them especially suited for ribbons. They may readily be embossed, as may also many of the other bonded-web fabrics.

CONCLUSION

I have attempted to point out something of the range of physical properties that may be built into bonded-fiber fabrics as have been produced over the past several years and the basic principles which form the foundation of their construction. Upon this foundation new and improved methods are constantly being developed, some of which I have touched upon and others which I am not as yet at liberty to mention. The variety of properties this material possesses has opened hundreds of uses for it. With the developments underway for its more economic production with improved drapeability, wear resistance and other desirable properties, much greater expansion may be expected. Bonded-Fiber Fabric is truly a versatile material which may hold its head high in any company.

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Southeastern Section——

AVCOSET* STABILIZATION OF RAYON FABRICS**

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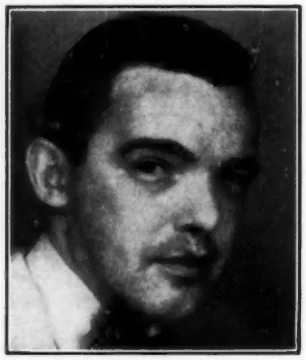

I H Welch

After a discussion of the historical development of finishes designed to give stabilization to rayon fabrics, the author describes the application of the "Avcoset" finish, which contains "Avcoset C", an alkali-soluble cellulose ether, and formaldehyde as the principal ingredients. Experimental data are shown to prove that "Avcoset" finishing gives stabilization to rayon fabrics for several washings without danger of tendering. These same experiments show that fabrics stabilized with nitrogen-containing compounds and formaldehyde not only do not give true stabilization for several washes, but nitrogen in such finishes holds chlorine from chlorine wash formulas, which later causes tendering.

Note: Since the time of the presentation of this paper on May 3rd, the "Avcoset" formulation has been simplified by the introduction of a water soluble hydroxy ethyl cellulose, "Avcoset WS," of the alkali solution hydroxy ethyl cellulose "Avcoset C." The use of this material eliminates the necessity of caustic soda and ice in dissolving the cellulose ether, and also replaces sulfuric acid with sodium bisulate as the catalyst. Aside from simplicity, the new "Avcoset WS" offers versatility of hand unobtainable with "Avcoset C." The amount of cellulose ether may be greatly increased to offer permanent stiffness if desired, also durable water repellents may be added for spot resistance or fullness. The properties of shrinkage control of the "Avcoset C" application are maintained fully with the "Avcoset WS" formulation.

J A Woodruff

INTRODUCTION

STABILIZATION of rayon fabrics, or shrinkage control as it is often called, means the retention of useful dimensions during normal wearing and cleaning. Since wet cleaning usually has a much greater effect on dimensions than does dry cleaning, it is the main reason for this discussion. The only limitation placed on the conditions of wearing or cleaning is that of common sense. One does not normally scrub the face of a bridal satin with a stiff brush nor take spots out of spun rayons with mineral acid. At the same time, if a garment is sold as washable, then it is reasonable to expect that a properly operating automatic washing machine would do it no harm in many washing cycles as well as in only one. Also, the choice of detergents should need only common-sense restrictions. This is the kind of stabilization or shrinkage control in which we are interested.

For some time there have been two different approaches towards obtaining various degrees of stabilization of rayon in finishing:

I) The use of alkaline or aldehyde chemical treatment of rayon fabrics combined with mechanical relaxation to give permanence of stability.

II) The use of resin treatment of fabric combined with mechanical relaxation resulting in stabilization of widely varying durability.

At this moment it can be definitely stated that this second approach has often failed to meet the requirements expressed in the opening paragraph. Data will be presented later in the paper to show what limitations cause these failures.

The first approach of aldehyde treatment followed by relaxation or compressive shrinkage has just recently become a practical and commercial realization. This approach will be treated in the following order: history of development, effect on rayon fibers, and necessary basic principals of mechanical application.

HISTORICAL

FORMALDEHYDE METHODS——The chemical treatment of rayon was developed quite a few years ago, possibly starting with a prolonged formaldehyde treatment of fabrics in an acid solution. This reaction chemically changed the rayon, reduced its swelling tendencies in water and increased the slope of the stress-strain curve. This process was not well adapted to continuous processing and, although the batch technique was improved gradually over the years, it never reached popularity. Gradually the use of urea-formaldehyde resins displaced the straight formaldehyde-reaction technique. The objective as a finish was largely crease resistance, since the fabrics were not of the type that would be wet-cleaned.

ALKALI TREATMENT——With the advent of spun rayons, the desire for stabilization increased, and many avenues of attack were pursued. The urea-formaldehyde and melamine-formaldehyde resins were worked with extensively, but the first real stability came from a treatment with strong alkali followed by a rapid neutralization. This reached commercial application as the "Definize" process. This alkaline treatment

* Trade-mark.
** Presented by J A Woodruff before the Southeastern Section in Columbus, Ga, on May 3, 1952.

is interesting in that it can produce fabrics having shrinkage control without lowering appreciably the degree to which the treated rayon swells in water. The rayon fabric loses its tendency to shrink progressively, perhaps by relaxation of the strains placed in the fibers during manufacture. Such a treated fabric will grow when wetted and then shrink back to dimension when dried. The action of an untreated fabric is similar except that it will progressively shrink more on drying than it grows on wetting.

GLYOXAL———The use of other aldehydes in a manner similar to formaldehyde brought about glyoxal application with an acid catalyst in the presence of heat. As with formaldehyde, glyoxal reacts with the cellulose to give to the resultant fabric reduced water absorptiveness and to its stress-strain curve an increased slope. With the decreased water absorption or water swelling, the growth and shrinkage occurring in wetting and drying cycles is greatly reduced. The change in stress-strain curve is desirable in that the fabric shows improved resistance to creasing and improved resistance to the wearing action of laundering cycles. The alkaline approach does not have the advantages that are shown by the aldehyde treatments. Both the alkaline and the aldehyde treatments have caused inconsistent damage to the rayon because of the difficulties in controlling the reactions during application.

EARLY AVCOSET FINISHING——— Although the effect of these three chemical treatments when properly applied is permanent, they only provide the elimination of progressive shrinkage and must depend on proper relaxation or compressive shrinkage and must depend on proper relaxation or compressive shrinkage to give satisfactory dimensional stability in the first wash. To accomplish this consistently on ordinary finishing machinery is not easy since the least pull along the warp will extend the fabric and, therefore, depending on the equipment and the care used, the fabric may have from 0 to 5.0% shrinkage in the first wash while the additional shrinkage in subsequent washings would be negligible. The CCC-T-191a cotton wash procedure is used for this testing. What can be done to bring about a greater resistance to this distortion during final finishing? The answer in aiding in this finishing has been found in adding surface-bonding materials to the chemical treatment. This is the story of "Avcoset" where an alkali-soluble cellulose ether is mixed with formaldehyde and, with less than 1% of these materials permanently added to the fabric, an entirely new system of stabilizing has been developed giving good uniformity of control over both the initial wash and all the subsequent washings.

TABLE I

AVCOSET PROCESS

a) **PAD**, with pickup of approx. 70%.

b) **FRAME**, at 240 to 280° F and ½ inch over width.

c) **CURE**, for 5 minutes at 315° F to 1 minute at 340° F.

d) **WASH**, at 160° F with soda ash and detergent at pH 9 and with material in *relaxed* condition.

e) **DRY**, on overfeed pin tenter, loop, or airlay dryer with material in *relaxed* condition.

f) **FINISH**, with material in *relaxed* condition on a steam frame, decatizer, calender, or Sanforizer.

The development of "Avcoset" has greatly improved the consistency of results dependent on mechanical handling as well as it has provided good control of the reactions that might tend to damage the rayon. The early development started with the application of alkali-soluble cellulose ethers to rayon materials. These ethers were precipitated on the surface giving added body and stiffness with considerable permanence. At the same time, it was found that these ethers helped to reduce the shrinkage of rayon fabrics, but only when fairly large amounts of the ethers were used. The change in hand resulting from this heavy application was too great for acceptance on a wide range of washable garments. Attempts were made to cut down on the amount of cellulose ether and to aid in the shrinkage control by adding a formaldehyde solution with acid in a coagulating bath. This made a two-bath procedure and, although difficult to control, did show excellent promise of stabilization of rayon. About three years ago it was discovered that, if the formaldehyde was added to the solution of an alkali-soluble cellulose ether, it was then possible to titrate the solution with sulfuric acid from the caustic-alkali pH down to a pH of 1.3. Without the formaldehyde, the ether would aggregate in an unmanageable gel. Actually, this pH of 1.3 was found, after many trials, to be the optimum for rayon.

AVCOSET PROCESS

The "Avcoset" process is the result of this combination of "Avcoset" C (alkali-soluble cellulose ether) and formaldehyde applied at a pH of 1.3, dried, cured, washed and relaxed-dried. The cellulose ether contributes at least two advantages: the first is that the fabrics can be handled in finishing with less danger of impairing stability, and the second, that many of the dangers of inconsistent formaldehyde combinations are greatly reduced. It is impressive to note that, if the "Avcoset" C cellulose ether is omitted from the mix with everything else constant, the net result will be badly damaged rayon. Mechanically "Avcoset" chemicals are applied in a routine fundamentally the same as for many of the cured-resin applications: pad, dry, cure, wash, dry, and finish (Table I).

PADDING———As the pad liquor forms a rather viscous mix, it is recommended that a long pad box be used in the application of the "Avcoset" mix, preferably with a double immersion in front of the nips. A double immersion aids in obtaining an even surface saturation before actual completion of the impregnation at the pad rolls. The pad rolls should be normal rolls, 12-20 inches in diameter and operating at pressures of 200 to 400 pounds per lineal inch. The double immersion before the nip naturally causes some tension, but tension at this stage is beneficial to ultimate dimensional control. As a result of this tension, the dyed goods going through the pad will be stretched from 3 to 7%. It should be remembered that, prior to the padding, the goods have just come from a scouring, dyeing and drying routine and have accepted some of the expected processing loss. "Avcoset" fabrics can show less processing loss than other methods, if desired.

FRAMING———After padding, it is accepted practice to run the cloth immediately to a clip tenter dryer where it is pulled out to the desired width for setting and then dried. Since considerable formaldehyde is given off into the air at the entrance and exit of this dryer, provision must be made to vent these fumes; otherwise, during production an intolerable odor condition will develop. The drying is best done at temperatures around 240° F.

CURING———The next step is curing. This can be done without tension or with tension as desired. It is recommended that curing be carried out at 330° F for 2½ minutes. Lower temperatures require longer times, and higher temperatures, shorter times. Be sure of your temperature—good control results in better curing.

WASHING ——— After curing comes washing, which is done to provide neutralization of the chemicals remaining on the fabric, to remove excess salts and to provide an opportunity for wet relaxation. The best relaxation appears to be obtained in a rope-style wash. A satisfactory wash can be obtained in a continuous open-width tensionless machine but it is easy to understand that flexing of fabric in the rope form will give a softer, fuller finish, which is not obtainable on continuous open-width treatment. The goods may shrink as much as 5% in this relaxed washing. Washing is normally carried out from 120 to 160° F at a pH of 9.0 to 10.0 and in the presence of a synthetic detergent. After washing, a water rinse or two is given to clear the fabric and to remove detergent.

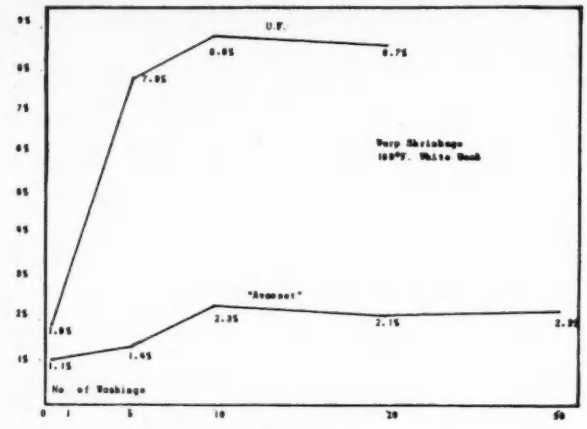

Figure 1
Warp Shrinkage from Washing

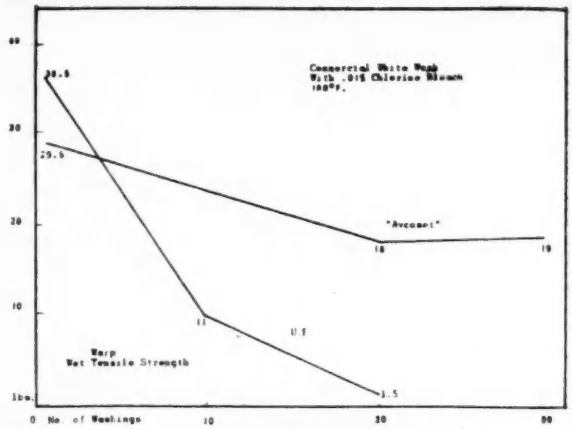

Figure 2
Wet Tensile Strengths After Chlorine Washes

DRYING———The final step of relaxation is drying. The preferred equipment is an overfeed pin tenter feeding to the fabric as much relaxation as the fabric will take. Usually, this is in the range of 2 to 4% on spuns. For many end uses, drying on a pin tenter can be the final operation. However, for a smooth finish, it is sometimes necessary to run the goods through a steam framing, which will remove any slight ripple that still remains. A stretching of 1 to 2% normally takes place in steam framing without tension. This will be followed by roll up or possibly by semidecating. Sometimes, on continuous-filament fabrics, calendering will have to be the final finishing operation in order to obtain the desired glossy surface.

Although the overfeed pin tenter is preferred, there are many loop dryers and airlay dryers which can be used readily for "Avcoset" treatments. Relaxation in drying on either of these machines is usually sufficient for stabilization. Since the fabrics will not have a finished appearance after drying, they are usually run over a steam frame with as little tension as possible, except where necessary in the filling direction to bring the fabric to proper width. For many fabrics, it is possible to use a Sanforizer as the final finish when such a machine is available.

FINISHING———It must be understood that, in finishing for stabilization with any chemicals all the operations following curing must be consistent with respect to either relaxation or tension. If care is not taken, then it would be best to leave shrinkage control out of the label and out of the advertising of the finished fabric. If someone doesn't like the finished hand, then one must not blithely put the fabric through a calender under tension and expect the stabilization to remain without change. No treated textile fabric can be abused and still retain stability to the first wash. Chemical treatment takes care of progressive shrinkage, but relaxation finishing controls the first wash test. It is not at all difficult to do good work, but one must follow the basic rules.

In order to aid glyoxal application, it has been suggested to add certain resins to the glyoxal and catalyst in order that these resins might act in a manner similar to the role of the alkali-soluble cellulose ether in the "Avcoset" process. These added materials (2 to 10%) will help to give consistency to the initial stabilization achieved by the glyoxal treatment. These resins may be lost during laundering to a considerable degree, but the shrinkage control is maintained because of the durable glyoxal reaction with the cellulose. Unfortunately, the addition of these resinous materials impart to the fabric the undesirable property of chlorine retention.

In the past few years a few other chemicals have been developed which are described as modified urea-formaldehyde resins or as stable condensable aliphatic compounds. There is no doubt but that these chemicals can produce stabilization of greater permanence to laundering than can be obtained with urea-formaldehyde or melamine resins and at the same time can provide good crease resistance. The results of experimental trials at the Textile Research Department have shown that stabilization with these chemicals is not quite so good as obtainable with aldehyde treatment. The cost of these new materials is considerably higher and chlorine retention can easily be detected.

RESIN FINISHES

Going back to method II, which deals with resin applications, such as urea-formaldehyde or melamine-formaldehyde, one should know just what can be expected from a finish. These resin treatments offer fine opportunities for modifying the hand

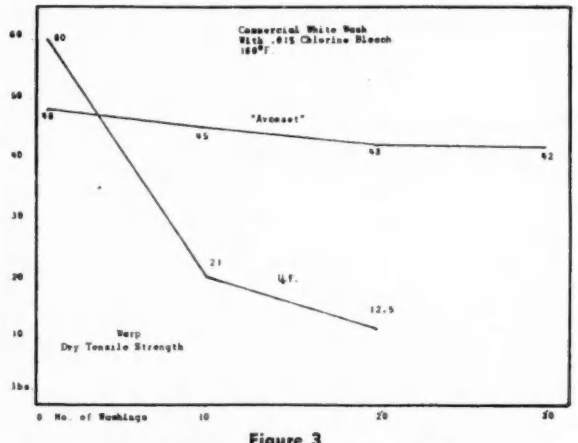

Figure 3
Dry Tensile Strengths After Chlorine Washes

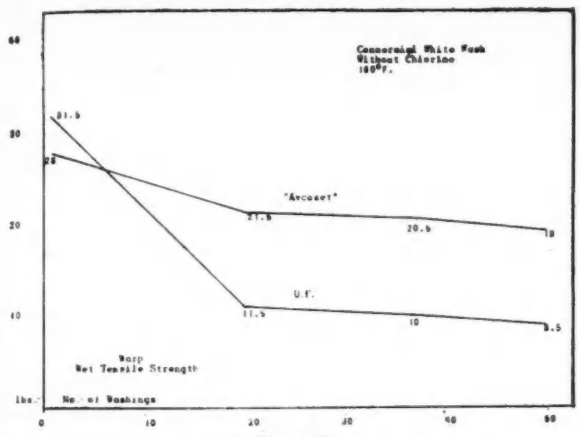

Figure 4
Dry Tensile Strengths After Washes Without Chorine

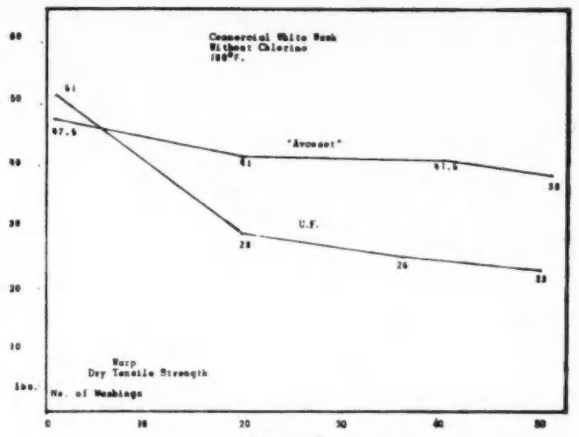

Figure 5
Wet Tensile Strengths After Washing Without Chlorine

and appearance of rayon fabrics. For improving crease resistance and to give a buoyant fullness of hand, there is no better finishing treatment. At the same time, the fabric will gain somewhat in dimensional stability over an untreated fabric.

There have been many descriptions written of the methods of application of these mentioned resins and mill experience is widespread. It does not seem necessary, therefore, to go into detail on the procedures of application. Most of the routine follows the procedure already given for "Avcoset" with a few exceptions. The main exception is that, in applying resins and aiming for maximum bulk and crease resistance, it is best to have relaxed conditions during padding, drying and curing. Naturally, the relaxed method used with the resins will yield less finished yardage but it must be done in order to obtain the best crease resistance and fullness of hand. It is expected that different standards of hand will be established in the future to distinguish between a finish for crease resistance and a finish providing stabilization for better satisfaction in end uses involving washing.

In order to obtain a relatively low degree of objectionable progressive shrinkage during the useful life of a garment, it is necessary to wash and dry the material in a relaxed condition following the curing step in resin application. Failure to do so will result in a hand which changes drastically during the first washing cycle and also will cause the goods to give a relatively poor first wash test to be followed by bad progressive shrinking in use. It should be recognized that those finishers who skip the washing step after resin curing are losing all chances of gaining stability and are giving the consumer a cheap nondurable finish. The abrasion resistane of the fabric can also be materially affected by this omission of washing. Any converter who asks the finisher to take such short cuts for a penny reduction must accept the penalty of selling inferior goods.

TESTING

SHRINKAGE ——— There have been many advertisements in the trade papers and on hang tags stating "2% residual shrinkage". In order to find out what this means, samples of these advertised fabrics were bought and given wash tests of various types. It was supposed that all these fabrics had been treated with resins. The results of wash tests without chlorine were in general as shown in Figure 1. Some of the resin-treated fabrics were better than shown by the UF curve in Figure 1, but all of them showed progressive shrinkage considerably above 2%. Also, many had a shrinkage in the initial wash tests greater than 2%. The conclusion has been reached that only one wash test can be considered if these fabrics so tested are to be said to have 2% residual shrinkage. A shrinkage of 2% in the first wash test and from 4 to 8% after five washes would be a more accurate description. Wash tests such as the CCC-T-191a cotton wash test at boiling temperatures will cause higher shrinkage values for resin-treated fabrics than will be shown by washes at 120 or 160° F. However, after the 120° F wash tests have been repeated five or ten times, considerable progressive shrinkage will be noticed.

CHLORINE RETENTION ——— Why should one process be favored over another? It is necessary to go back to the start of this paper and reread the comment about normal wearing and cleaning. Many garments, if labeled washable, will be exposed to the action of a chlorine bleach during normal cleaning. This is especially true of such garments as white or light-colored shirts, dresses or pajamas. The "Avcoset" fabrics will not retain chlorine after such exposure. However, all the nitrogen-containing resins, which are presently advertised as providing shrinkage control, will pick up chlorine from the laundry bath and retain it unless an antichlor is used. No antichlors are used today in home laundries, and they are used in very few commercial laundries. Following this chlorine contact and absorption come drying and pressing. During pressing, the chlorine is released as hydrochloric acid, and the strength of the cellulose fibers is rapidly reduced (Figs 2 & 3). This then is an excellent reason for preference for "Avcoset" fabrics.

WASHING WITHOUT CHLORINE— The tensile strength of materials is affected by washing mostly because of abrasion in the washing machine and the tumbler dryer. Figures 4 and 5 show the wide differences in tensile strengths exhibited by urea-formaldehyde treated fabrics as compared with "Avcoset" fabrics in several washings without chlorine. Both the wet- and dry-tensile figures show the "Avcoset" to be very superior to the resin-treated fabric. Note that the resin-treated fabric has an initial strength in all cases which is high but drops very rapidly below the line traced by "Avcoset". This increased resistance to laundering abrasion appears to be typical for rayons reacted with aldehydes in general.

ADVANTAGES OF AVCOSET FINISHING

Many people have complained that the laundries charge approximately double price for cleaning a colored sport shirt as compared with a regular dress shirt. Vat-dyed and "Avcoset" rayon fabrics can readily qualify for the cheaper price. They will not bleed, they will retain their nor-

mal dimensions, and they can be pressed with remarkable ease. This type of performance will allow rayon to enter into end-use categories for which it was not suitable previously.

One interesting feature of "Avcoset" fabrics is the reduction of raveling along cut edges and the elimination of the tendency to curl which is exhibited by resin-treated or untreated rayon fabrics on washing. The performance of an "Avcoset" satin fabric is very striking. After several CCC-T-191a cotton wash tests, the face of the fabric is still clear and glossy with the hand unimpaired. The same fabric without "Avcoset" treatment was unusable because of shrinkage, curling and disturbed face after only a few such wash tests.

LICENSING———Although there is no fee for the use of "Avcoset" chemicals or the use of the name, it is required that all converters, dyers and finishers sign a licensee agreement with the American Viscose Corporation. Fabrics or garments labeled "Avcoset" may be subject to testing by the American Viscose Corporation at any time.

The Textile Research Department of the American Viscose Corporation has been responsible for the development of the "Avcoset" technique. This work has been a group effort by several members of the Dyeing and Finishing Division of the above department. The objective of the work has been, and continues to be, to provide improved finishes for rayon so that rayon can continue to expand its application. Through the use of "Avcoset" fabrics, the field of washable fabrics, such as shirtings, sheetings, dresses, children's apparel, and so forth, can be enjoyed by rayon.

AVCOSET RECIPE———The following formula gives a list of the chemicals contained in 100 pounds of the "Avcoset" solution:

	Pounds
"Avcoset" C	1.0
dry caustic soda	1.3
formaldehyde, 37% soln	10.0
sulfuric acid, 66° Bé	2.7
water	85.0
Total	100.0

Information for the preparation and application of "Avcoset" finishes will be provided by representatives of the Textile Research Department of the American Viscose Corporation on request.

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Western New England Section Meeting Report

A MEETING of the Western New England Section was held on November 14, 1952 at Rapp's Restaurant, Shelton, Conn. The speaker of the evening was C E Gibson of the Dow Corning Corporation who presented a talk on "Textile Applications of Silicones". Among the typical uses described were those for imparting water repellence and lubricity and for improving abrasion resistance of thermosetting resin treated fabrics. Other silicone products which find use as antifoam agents, lubricating greases or liquid and in high-temperature insulation were also discussed.

Chairman R C Geering announced the appointment of the chairmen for various committees for 1953. The appointment of a local committee on Stream Pollution under the chairmanship of A N Henschel was also announced with a request for additional volunteers.

Approximately forty-five members and guests were present at the meeting.

Respectfully submitted,
A S NYQUIST, *Secretary*

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Meeting Report—Hudson-Mohawk Section

October 3, 1952
Jack's Restaurant, Albany, N Y

THE first fall meeting of the Hudson-Mohawk Section was held on Friday, October 3, 1952 at Jack's Restaurant, State Street, Albany, New York. Thirty-five members were present.

Paul Jacobs, Technical Service Representative, Onyx Oil and Chemical Company, Jersey City, New Jersey, presented a paper entitled "The Quaternary Ammonium Salt—A New Versatile Chemical for Textile Processing".

Respectfully submitted,
WILLIAM A NELSON, *Secretary*

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4th Annual Outing—Hudson-Mohawk Section

ONE HUNDRED AND SIXTEEN members and guests were present for the 4th Annual Outing of the Hudson-Mohawk Section on June 20, 1952 at the Wolfert's Roost Country Club, Albany, New York.

A large number of door prizes were awarded to members and guests with the five principal prizes being awarded as follows: *1st,* Arthur Anderson, National Aniline; *2nd,* Harry Aylward, Surpass Chemical Company; *3rd,* Warren Broadbent, Geigy Co, Inc; *4th,* Harold Burt, Perry Knitting Co; *5th,* A L Van Wart, Arnold Hoffman Company.

Fifty-two golfers competed for the Ciba Trophy, which was put up for the first time this year. The first leg (3 legs are necessary for permanent possession) was won by Frank Murphy, Cluett, Peabody & Company, Inc, with a 77; 2nd low gross was Bob Quiri from Ritter Chemical Company with an 80; 3rd low gross was Bob Cox, Solvay Sales with an 81.

Other golf prizes were awarded for the closest to the pin on the 185-yard 15th. Paul Mansuay of Procter and Gamble was nearest followed by Dan Lipman and George Allen.

The longest drive of the day was posted by William Nelson of Ritter Chemical with 282 yards. Second with 266 yards was Frank Murphy of Cluett, Peabody & Company closely followed by Bob Cox, Solvay Sales, with 265.

Prizes in the kickers tournament were awarded to Art Thomas, Ernest Allard, Robert Peters, Everett Schmitt, Clayton Shuttleworth, Warren Carmussell and Harry Aylward. High score of the day was posted by Vic Christopher of Mohawk Carpet Mills.

Horseshoe doubles was won by Al Tompson, Palatine Dyeing Company and Walter Drautz, General Aniline Works.

Harvey Gendreau, Sandoz Chemical Works, headed the Outing Committee which consisted of the following:

Prize Fund—Jack Epelberg, Cluett, Peabody & Co, Inc

Reservations and Door Prizes—John W Merrill, Cluett, Peabody;

Printing—William A Nelson, Ritter Chemical Co, Inc;

Golf—Harvey Gendreau, Sandoz Chemical Works; Warren Broadbent, Geigy; A Del Truman, Triangle Finishing Co, Inc; Frank Murphy, Cluett, Peabody Co

Cards — Mal Coulman, Onyx Oil & Chemical Co; Ernest Allard, Cluett, Peabody; H Mongovan, Calco Chemical Division, American Cyanamid Co

Softball — Victor J Christopher, Mohawk Carpet Mills, Inc; Floyd Szurek, Mohawk Carpet Mills, Inc

Horseshoes and Darts—Walter Drautz, General Aniline Works;

Tickets — George P Hahlweg, Ritter Chemical Co, Inc; Walter Kitaj, Cluett, Peabody

Publicity — Leonard S Lang, Cluett, Peabody;

Entertainment—David O Hamer, Arkansas Co, Inc

Photography and Movies — George Brandeis and Jack Epelberg, Cluett, Peabody

Ciba Trophy—Al Grimm and Ken Leslie, Ciba Company.

Respectfully submitted,
WILLIAM A NELSON, *Secretary*

(Outing photos appear on Page P885 and P886)

HUDSON-MOHAWK SECTION OUTING

JUNE 20, 1952

WOLFERT'S ROOST C C
ALBANY, N Y

(L to r): E Allard, Cluett, Peabody & Co, Inc; E Fell, Stevensons-England; J Epelberg, Cluett, Peabody.

(L to r): E R Palmatier, Bigelow-Sanford Carpet Co, Inc; M Brelke and D Lipman, Stein Hall Company; R I Peters, Bigelow-Sanford.

Frank Murphy, Cluett Peabody—Winner of the Ciba Trophy for Low Gross (77).

(L to r): H Levitt, Cluett, Peabody; I Smith, Surpass Chemical Co; L Lang, Cluett, Peabody.

Al Grimm (left), Ciba Company, presents the Ciba Trophy to Frank Murphy.

(L to r): H Gendrau, Sandoz Chemical Works, Inc; R Meyer, A Tompson and H Dunlap, Palatine Dyeing Company.

(L to r): R Mackey, J Soltys, G Cornell and L McNamara of Mohawk Carpet Mills.

A Hulsebosch, International Salt Company, checks his card with H Gendrau (Sandoz), Chairman of the Outing Committee.

(L to r): C Ballone, Country Craft Mills; P Mansuy, Procter & Gamble, Inc; W Nelson and R Ritter, Ritter Chemical Co, Inc.

(L to r): J Epelberg, Cluett, Peabody; H Gendrau, Sandoz; A Tompson, Palatine Dyeing; W Drautz, General Aniline Works; A Grimm, Ciba Co, Inc; F Murphy, Cluett, Peabody; W Nelson, Ritter Chemical.

Standing (l to r): M Foley, Wolfert's Roost C C; I Smith, Surpass Chemical; H Levitt and J Epelberg, Cluett, Peabody. Seated (l to r): W Drautz, C Streck, A Herrmann and J Feyler, General Aniline; J Morris, Wilson Bros.

E Britton, H Levitt, E Fell, E Allard, L Lang and F Murphy, Cluett, Peabody & Co, Inc.

(L to r): E Rosenblum, Star Woolen Co; I Rubenstein, Cohoes Textile Printing Co; H Bellinson and J Horsfall, Cluett, Peabody.

Group singing led by Irv Smith, Surpass Chemical. Vocalists include Clayton Shuttleworth, Floyd Szurek, Tony Cassetta (with back to camera), Vic Christopher, Carson Thompson and John Soltys of Mohawk Carpet Mills.

(L to r): A Anderson, National Aniline; W Zabe, Fonda Glove Lining Co; M Rosenblum, Star Woolen Co; R Hardcastle, Fonda Glove Lining Co.

(L to r): J Merrill, E Fell, J Epelberg, H Levitt, E Allard and F Murphy, Cluett, Peabody & Co, Inc.

(L to r): I Smith, Surpass Chemical, J Epelberg, Cluett, Peabody; W Nelson, Ritter Chemical.

(L to r): C Shuttleworth, F Szurek, V Christopher and A Casseta, Mohawk Carpet Mills.

(L to r): Unidentified; H Burt, Perry Knitting; J Smith, Surpass Chemical; E Chevrette, Apex Chemical.

ABSTRACTS

The Value of Processing Aids in the Handling of Fibers and Fiber Blends

P T Gale and H Sagar, *J Textile Inst* 43, P496-506, August, 1952.

The authors discuss static electrification of fibers and yarns; processing aids for staple fibers; fiber lubrication; and warp sizes. This abstract is concerned only with that portion dealing with static and its control.

The static problem has been intensified by the introduction of such hydrophilic fibers as nylon, Terylene (Dacron), Orlon, and acetate rayon.

Wool and other protein and polyamide fibers, such as Ardil, casein fibers, and nylon, normally develop positive charges, while the cellulosic fibers, cotton, flax, viscose and acetate rayon develop negative charges. In regions of low and moderate charge, however, the sign of charge is frequently reversed, possibly owing to induction and capacity effects.

Broadly speaking, three methods are available for the control of static electrification:

(i) The maintenance of high atmospheric humidity.
(ii) The employment of means to ionize the surrounding atmosphere, which may consist of a radioactive source or a high voltage point discharge.
(iii) The use of antistatic agents.

Recently, certain ethenoxy compounds containing long alkyl chains or alkylaryl groups in the molecule have been found to be excellent antistatic agents for wool, and function satisfactorily on both classes of fibers mentioned above. If the fiber is processed within a few days of application of the antistatic agent, very small quantities of certain nonionic ethenoxy compounds or cationic surface active agents, e g, 0.05 per cent of the weight of fiber, are sufficient to reduce to very small proportions the charge generated during carding.

Antistatic preparations for application to viscose and acetate staple fibers have been advocated, which contain mineral oil plus anionic surface active agents, while a naphthalene sulfonic acid-formaldehyde condensate has been used as antistatic finish for Perlon staple.

Lubrication of continuous filament yarns, e g, nylon and acetate, during winding or coning, coupled with adequate humidification, minimizes electrification of the filaments. Further advantages can be gained by the inclusion of suitable antistatic agents. A number of products are recommended by the authors for this purpose.—WHC

Microscopical and Biological Examination of Wool

J L Stoves, *Textile Inds & Fibres* 13, 218-20, July, 1952.

Bacteria. Intact wool fibers are very resistant to bacterial degradation; only after the cuticular layers have suffered chemical or mechanical damage can such attack take place. Bleaching, chlorination, overscouring and photochemical degradation can therefore pave the way for damage by bacteria. The presence of nutrient material, such as fats or glue, on the surface of nondamaged fibers facilitates bacterial activity. Optimum conditions for the growth of proteolytic bacteria are a slightly alkaline pH of 7.2-8.2, temperature range 30-37° C, and a high moisture content.

The following are effective bactericides: p-chloro-m-cresol, pentachlorophenol, organic mercurials, chromium or copper salts. The author discusses qualitative and quantitative tests for the estimation of bactericidal efficiency.

Molds. Conditions favoring growth of mold fungi are in general similar to those already described for bacterial growth. Moisture requirements and optimum growth temperatures of fungi are lower than those for bacteria. Fungi are less sensitive to pH variations and grow in acid as well as mildly alkaline conditions. The first indication of mold activity is the development of a characteristic musty smell. Later, the well-known "moldy" blue or pink coloration develops, with the formation of permanent staining and chemical degradation of the wool.

When mildew is suspected, a sample of the wool can be shaken with melted Dox-Czapek agar (the composition of which is given), poured into a sterile Petri dish and incubated at 25° C for several days.

Satisfactory preventive treatment consists of impregnating the wool with a fungicide, which may be organic or inorganic in nature. The anilide of salicylic acid is widely used, incorporated in sizes and finishes.

Moths. Moths are reportedly responsible for damage to wool textiles in England of the order of £1,000,000 a year. Fumigation kills larvae but offers no subsequent protection to the goods. Essentially this is a process for use when pests have reached the stage of being a serious menace. Prussic acid, sulfur dioxide, carbon disulfide, and halogenated hydrocarbons are used. Paradichlorbenzene is distasteful to moths and acts as a deterrent. The most satisfactory method of mothproofing wool, however, is to add to it some agent which renders the wool permanently immune to larval attack. The Eulans and Mitin FF are suggested as suitable examples, possessing good fastness to washing. DDT has less wash fastness but only a small amount gives good protection.

The author discussed tests to determine the amount of the various moth proofers on the wool surface.

Beetles. Carpet beetles, although less of a menace than moths, attack carpets, wool textiles, furs and hides. The same protective measures are used as in the case of moths.—WHC

The Reduction Properties of Vat Dyes

W J Marshall and R H Peters, *J Soc Dyers Colourists* 68, 289-99, August, 1952.

In modern dyeing processes, although leuco dyeing and padding are widely used, it is often desirable to improve the penetration of the dye into the fiber, and for this purpose a common expedient is to pad the dye onto the fiber and then treat the material in a reducing bath, in which reduction and dyeing take place simultaneously. Such, for example, are the pad-steam, the Abbot-Cox, and the Standfast molten-metal processes. In some of these modern methods, the time available for the processes of reduction and dyeing may be as short as 5 seconds. In these cases, reduction is as much an integral part of the dyeing process as is adsorption. The authors therefore decided to study the reduction properties of different vat dyes.

Reduction can be defined in terms of two factors: rate and equilibrium. The equilibrium of reduction was measured in terms of the redox potential. The results for 19 vat dyes are listed, and show a wide range, indicating that the reduction equilibrium of these dyes is likely to vary enormously, depending on the strength of the reducing agent used.

Regarding the rate of reduction, there are enormous differences between different dyes. The authors list the rates of reduction and recommended vatting temperatures of 14 dyes. The extreme high and low rates are shown to differ by a

factor of 600 times.

As a result of this study the authors conclude that the investigation of reduction processes is a very important (and yet hitherto neglected) aspect of vat dyeing. It is shown that the reduction properties of vat dyes largely determine the behavior of the dyes in printing and in many modern methods of dyeing, and may be more important in such cases than affinities and rates of diffusion, which in the past have been considered sufficient to define dyeing behavior. In printing, the primary factor is the equilibrium state, measured by the redox potential of the dye, which determines whether the dye will print. Further differentiation between dyes is then dependent on their rates of reduction. In dyeing, the use of a reducing agent which is much stronger than that commonly employed in printing leads to the complete reduction of all vat dyes at equilibrium, so that the rate of reduction alone is important in determining dyeing behavior.

It is also shown that the effect of the particle size of the vat dye suspension on rate of reduction is small as compared with the differences existing between different dyes, which are very great.—WHC

The Functionally Significant Properties of Some Newer Synthetic Fibers

J B Quig and R W Dennison, *Canadian Textile J* 69, 60-9, September 12, 1952.

Since it is recognized that the basic physical and chemical properties of the fiber raw materials determine the character of yarns, fabrics, final garments and other end products, the authors have endeavored:

(1) To list the advantages which are common to dynel, nylon, Orlon and Acrilan acrylic fibers, and Dacron polyester fiber.

(2) To point out the known functionally significant properties of each synthetic fiber and Vicara protein fiber.

(3) To consider how our present synthetic fibers differ from the natural fibers and other man-made fibers in certain important respects.

(4) To present evidence from textile research that the properties of synthetic fibers may be utilized to manufacture better fabrics and to show that the hydrophobic and the hydrophilic fibers are complementary to each other.

The authors present tables in which the various chemical and physical properties of each of the above fibers are listed, and curves showing stress-strain relationships and moisture regain. They describe experimental work which has been carried out by the du Pont Company on blending nylon, Dacron, and Orlon with rayon, acetate, and wool fibers.

While the data presented are considered preliminary, they indicate that blending techniques may employ the synthetic fibers with wool and rayon to increase strength, resistance to abrasion, dimensional stability, recovery from wrinkling, and retention of press; while wool and rayon may be employed with the synthetic fibers to modify pilling and burning by embers. The blending of wool with some of the synthetic fibers to augment crease recovery is also indicated.

Fourteen references to the literature are listed.—WHC

Dyeing in the Blended Fiber Hosiery Industry, with Some Observations on Finishing

C S Groves and C F Ward, *J Textile Inst* 43, P626-45, August, 1952.

The authors point out that there is one absolute essential which cannot be too strongly emphasized, and that is that no success can be achieved and repeated regularly in dyeing mixtures of fibers without a thorough knowledge of the properties and processes required by each individual fiber.

The usually available materials are divided into 5 groups:

(1) *Protein.* Wool, Ardil, casein and natural silk: resistant to acids but attacked by alkalis (for some purposes nylon can be included in this group).

(2) *Cellulose.* Cotton (natural and mercerized), regenerated cellulose, rayons, linen, and other bast fibers: all resistant to alkalis, but attacked by acids.

(3) *Esters.* Cellulose acetate: sensitive to acids and alkalis.

(4) *Polymers* not having amino groups. Terylene (Dacron), polyvinyl chloride fibers, acrylonitrile fibers: generally good chemical stability, but require careful control from point of view of physical properties, e g, luster and strength.

(5) Miscellaneous. Alginates, rubber, glass, cotton treated with amino resin, each having special properties.

Scouring and bleaching (hypochlorite, peroxide, and chlorite) are thoroughly discussed. The authors find that hydrogen peroxide is the only chemical which can be safely used on almost all fibers.

The discussion on dyeing is divided into three classes of material:

(1) Mixtures of wool with cotton, regenerated cellulose, nylon, Ardil, Vicara, acetate, and Rayolanda.

(2) Mixtures of cotton with Rayolanda, viscose, cuprammonium and acetate; also regenerated cellulose and Rayolanda.

(3) Miscellaneous synthetic polymer fibers.

The aim of the authors is to suggest lines of procedure, rather than to present a complete set of formulae for the dyeing of every possible mixture. Each of the above mixtures is discussed separately, with suggestions as to the most suitable classes of dyes to be used and the necesary precautions to be taken.

With reference to the control of the processing of blended materials, the most obvious requirement is that the composition of the material should be accurately known. Staining tests and the use of the microscope are usually sufficient to classify most mixtures in commercial use.—WHC

Symposium on Synthetic Fibers

Sponsored by the American Chemical Society, and published in *Industrial and Engineering Chemistry* 44, September, 1952.

SELECTION OF FIBER MONOMERS

W W Heckert (2103-9)

The author discusses the possible markets for new synthetic fibers, and mentions the tremendous cost of introducing a new fiber, including expensive, large-scale testing of the market. Synthesis of new fibers, he says, is a relatively easy task, but to select one for commercial exploitation is extremely difficult. His conclusions follow:

It is apparent that any existing approach to the selection of a new fiber for manufacture leaves much to be desired. We need a whole new science relating the functional performance of garments and textiles to their structure, the properties of the fibers from which they are made, and the conditions of service. This is a field in which there are innumerable variables. Only a small beginning has been made in unraveling some of the more important relationships. It is also clear that even in the face of exhaustive performance data and an accurate knowledge of production costs, it is not possible to predict market acceptance with any degree of accuracy except in a limited number of cases where all lines of evidence point in the same direction.

The appearance in rapid succession of a series of new synthetics has provided the textile industry with new degrees of freedom which are beginning to liberate a wealth of creative endeavor in the fields of fabric and garment design. To the alert in the textile industry, this represents opportunity. To those who resist change, this represents a hazard. To the ultimate consumer, this means an opportunity to choose between a vast array of new textiles offering superior values. To those of us who are interested in fiber

and textile research, this represents an opportunity to have a hand in the unfolding of a new branch of science. Our ideas will be tested not only in the laboratory, but insofar as they are embodied in new fibers and textiles, they will also be tested in the competitive struggle of the market place. From such exhaustive analysis should arise a clearer perception of the functional values of fibers and a crystallization of worthy goals for fiber research. Perhaps, if we are alert, we shall even be able to develop more precise and economical techniques for choosing between alternative fiber-forming monomers.

INFLUENCE OF MOLECULAR STRUCTURE ON PROPERTIES

H Mark (2110-14)

The following factors appear to be of particular significance for the development of good fiber-forming properties of a polymer: Average molecular weight should not be too low, because tensile strength, elongation to break, and resistance against abrasion and fatiguing decrease sharply as the degree of polymerization of the material becomes too low. Present experience indicates that too low molecular weight fractions cause brittleness, whereas too high molecular weight constituents can be responsible for difficult processing in filtration, deaeration, and spinning.

A tendency to form areas of crystalline character on stretching, slashing, or drawing is of importance in obtaining a compromise between tensile strength, transversal properties, and break elongation. Strong and regularly distributed intermolecular force centers, stiff segments in the chains, and symmetric arrangements of the substituents favor the tendency for crystallization. High softening point, low brittle point, and a high resistance against the attack of chemicals, oxygen, light, and microorganisms are also essential.

TENSILE PROPERTIES OF NEWER FIBERS

J H Dillon (2115-22)

The primary mission of a textile fiber is to bear a load and respond to changes in load during processing and service. There are many secondary but important qualities that it should possess, such as dyeability, chemical stability, and minimum static charge generation. Moreover, there are economic factors of price and availability which are often controlling. The types of loads to which textile fibers are subjected vary widely from the simple tensional to the more complex bending. Rates of loading vary from the essentially static to the impact and high frequency types found in parachute shrouds and tire cord. Response to load by the hydrophilic fibers is governed critically by the relative humidity of the environment, whereas the hydrophobic fibers are more sensitive to changes in temperature.

This paper is limited to a study of the tensile properties of several natural and man-made fibers. In accepting this limitation, however, it is acknowledged that the performance in tension of any fiber is only a part of the story of its load-bearing quality—an important part, but selected mainly because it is easier to measure the properties in tension than under the more complex conditions of processing and service.

In the first section of this paper, stress-strain curves to rupture are presented for single fibers of viscose rayon, acetate rayon, nylon, Orlon, Dacron, dynel, Acrilan, X-51, Vicara, and regenerated silk. The relative stress-strain behavior of these fibers is discussed in terms of their chemical structures, and the limitation of this type of evaluation is stated. In the second portion of the paper, repeated stress-strain data are presented in the form of "cycling profiles", and the viscoelastic properties of the various fibers thus revealed are compared. In the third section of the paper the effects of fiber morphology upon mechanical properties are discussed, and the effects of crimp on the measured Hookean modulus are given and interpreted.

COTTON

L K Fitzgerald (2164-6)

The newer synthetics, in their relation to the natural fiber, cotton, is the topic of this paper. These newer synthetics have been designated as nylon, Orlon, dynel, Acrilan, Dacron, and Vicara. This relation is discussed from the standpoint of a textile manufacturer, since that is where the author's training has been.

The opportunities and problems confronting cotton textiles as a result of the introduction of the newer synthetic fibers are discussed, together with examples of combinations of some of the newer fibers with cotton. The desirability of the properties contributed to cotton by some of the newer synthetic fibers is not debatable, but whether or not these combinations will prove commercially feasible is yet to be determined and will not be determined until sufficient time shall have elapsed to permit thorough consumer tests.

Since the current trend in the textile markets is toward lower-priced fabrics, it is expected that cottons and cotton blends with the older synthetics will continue to dominate the fabric markets. The effects of the newer synthetics on the markets for cotton will depend upon the consumer's willingness to pay for the unusual properties contributed by the new fibers. Meanwhile, it is shown that cotton continues to gain in consumption for apparel and household fabrics, and that these gains are greater than the total production of man-made fibers. The marked betterments that have come to cotton through chemical research are discussed in some detail, as well as related research in other cellulosic fibers, particularly viscose rayon, to which new properties are contributed by a new chemical treatment, known as X-2. It is necessary to emphasize the rayon development because from it are coming remarkable fabrics of rayon and cotton blends which are practical for the first time.

SILK

W S Kilborne (2166-8)

The relative position of silk in the textile industry has suffered a continuous decline since 1929. In 1951, only 5 per cent as much silk was brought into this country as was received in 1929. Silk, however, does have a combination of desirable assets that is not found in any of the synthetics.

Silk is a strong fiber. It has a tensile strength of 64,000 pounds per square inch. In comparing this with other yarns, only five are stronger: glass, flax, Fortisan, asbestos, and nylon, in that order. Weaker than silk are Tenasco rayon, cotton, steel wire, viscose rayon, vulcanized rubber, acetate, and wool.

Silk shares with nylon the honor of being the toughest of fibers, and its resilience is the envy of all the other fibers. It is warm in winter, cool in summer, and has a high resistance to twisting forces. With scientific cooperation and study, most of the problems connected with silk could be eliminated, and the future for silk would be much brighter.

ACETATE

A M Tenney (2171-5)

The author reminds us that the Federal Trade Commission's trade practice rules effective February 9, 1952, have established the following definition: *Acetate*: man-made textile fibers and filaments composed of cellulose acetate, and yarn, thread, or textile fabric made of such fibers and filaments.

Trends in per capita consumption of textile fibers for nonindustrial use in the United States, showing the relative favorable position of acetate fibers, are given for the past 20 years. A discussion of the economic relation of the natural and man-made fibers, as shown by textile fiber prices in the U S, suggests a current advantage for acetate filament yarn, and a present and probably future advantageous price for acetate staple fiber.

A study is made of the diversified use of the different fibers in fabrics and the widening acceptance of acetate because of its special characteristics. Such properties as resilience, plasticity, and dryness of acetate and the new man-made fibers

are discussed, and the relative importance of these characteristics in fabrics of each kind of fiber is enumerated.

Some recent developments in dyeing and finishing processes for fabrics containing acetate yarn and/or staple are mentioned, together with the probable increased demand for acetate fibers through their employment.—WHC

New Developments in the Chemistry of Chlorites

Meybeck, *Teintex*, 71-95 (Feb 15, 1952).

Systematic experiments carried out by the author and other scientists prove that the acid chlorite process gives best results as compared with other chlorite combinations such as with aldehyde, hypochlorite or persulfate. Even "Orlon" acrylic fiber can be bleached satisfactorily this way, it is claimed.

Further attempts have been made to use finely-divided, nonmetallic compounds or metals (Cr, Fe, Ni, etc) or salts thereof as catalysts. Good effects have been attained with strongly acid solutions (pH 3-3.5) at low temperatures (30-40° C). This method is preferred because ClO_2 (which does not act as a bleaching agent in itself) is not developed and because formation of chlorates is negligible. Cellulose fibers are practically free from attack but up to now no exact data regarding the optimum pH, concentration, temperature and reacting time, which bring about changes in the cellulose molecule, have been available.

The author states that increased concentration does not influence appreciably the degree of oxidation of cellulose within practical limits. Only by extending the reaction time to 21-99 hrs could some oxycellulose be found; figures obtained after 21, 75 and 99 hrs are reported. A distinct drop in degree of polymerization could be observed only after this prolonged action, while the reducing power (copper index) was surprisingly less than that of the oxycellulose produced in other treatments, evidently due to the formation of gluconic acid groups. Probably ester groups are present, tending to decrease reducing power and acidity and at the same time increase sensibility to acids and alkalis. Oxycelluloses obtained in this process show strong depolymerization characteristics in an aftertreatment with N/1 hydrochloric acid at 60° C.

Reactions of chlorite and chlorine dioxide on protein fibers were systematically investigated. Cold treatments appeared initially to have had a slight bleaching effect but on further treatment to have produced pink or brown shades. Reasons were found in the reactions of different amino-acids (especially cystine and tyrosine), which become brown in strongly acid media. (This phenomenon has been particularly studied by isolating the reaction products.) Practical bleaching methods based on these findings will be developed. Finally the action of chlorite on nylon, which is less influenced by this reagent, has been investigated. The reaction time has to be extended over 8 hrs. Photomicrographs of samples of stretched and unstretched nylon treated with chlorite are presented showing the principal differences, but no general conclusions have been drawn in this special field. (In French)—PW

Photographic Production of Screens for Printing Textiles

Welcker, *Teintex*, 101-109 (Feb 15, 1952).

Screens for textile printing are generally manufactured by photomechanical methods, using sensitized gelatin or polyvinylalcohol layers. Best results are obtained by first coating with a lacquer as a substratum for this layer. Used screens may be cleaned by removing the lacquer together with the pattern-forming gelatin, or by filling the uncovered spaces in used screens with fresh lacquer. Practical suggestions are offered for tending the frames with silk gauze, phosphorus bronze or nylon.

It is preferable that the lacquer be prepared in the plant from nitrocellulose or chlorinated rubber solutions instead of from "ready made" products since appropriate compositions are rarely available in the trade. The production and application of the sensitized gelatin layer is described with many details as is the process for producing the pattern by photographic methods and subsequent development. It is suggested that the screen be treated after exposure with ammonium dichromate to prevent possible swelling of the gelatinous layer in moist atmosphere. After removal of the unexposed, soluble portions of gelatin in the dark room the screen is dried in daylight. Removal of the lacquer layer on the unexposed portions has to be carried out by softly rubbing the surface with cloth moistened with solvent; excess of solvent must be avoided. A machine for carrying out this delicate operation by suction is illustrated. (In French)—PW

Practical Experience in Pigment Printing

Haller, A, *Melliand Textilber*, 317-319 (April, 1952).

The use of insoluble pigments (generally, inorganic compounds) in prints has been familiar for a long time, but the author notes that considerable progress has been achieved recently by processes developed by Interchemical Corp, using the Aridye colors. He discusses particularly the compositions of the water-in-oil type and the applications thereof.

Rubber rollers should be replaced by rotating brushes.

Grays are no more affected by this process than by other standard printing methods. They are best soaped energetically in rope form, left in the soap solution for 2-3 hrs and rinsed thereafter with hot and cold water.

Many advantages of this printing method are enumerated; among others: colors are readily visible in printing and faults can immediately be detected, the fastness is good, the pastes can be applied alongside other dyestuff groups and aftertreatment is much simpler than that of other dye groups. Tested formulas are offered regarding application prints (Aridye Blue FC2G), discharge prints containing Rongalite C and resists under Variamine Blue. Means of obtaining better fixation of colors by subsequent curing, developing them in acid steam alongside Rapidogens and other suggestions relative to printing and aftertreating are presented. (In German)—PW

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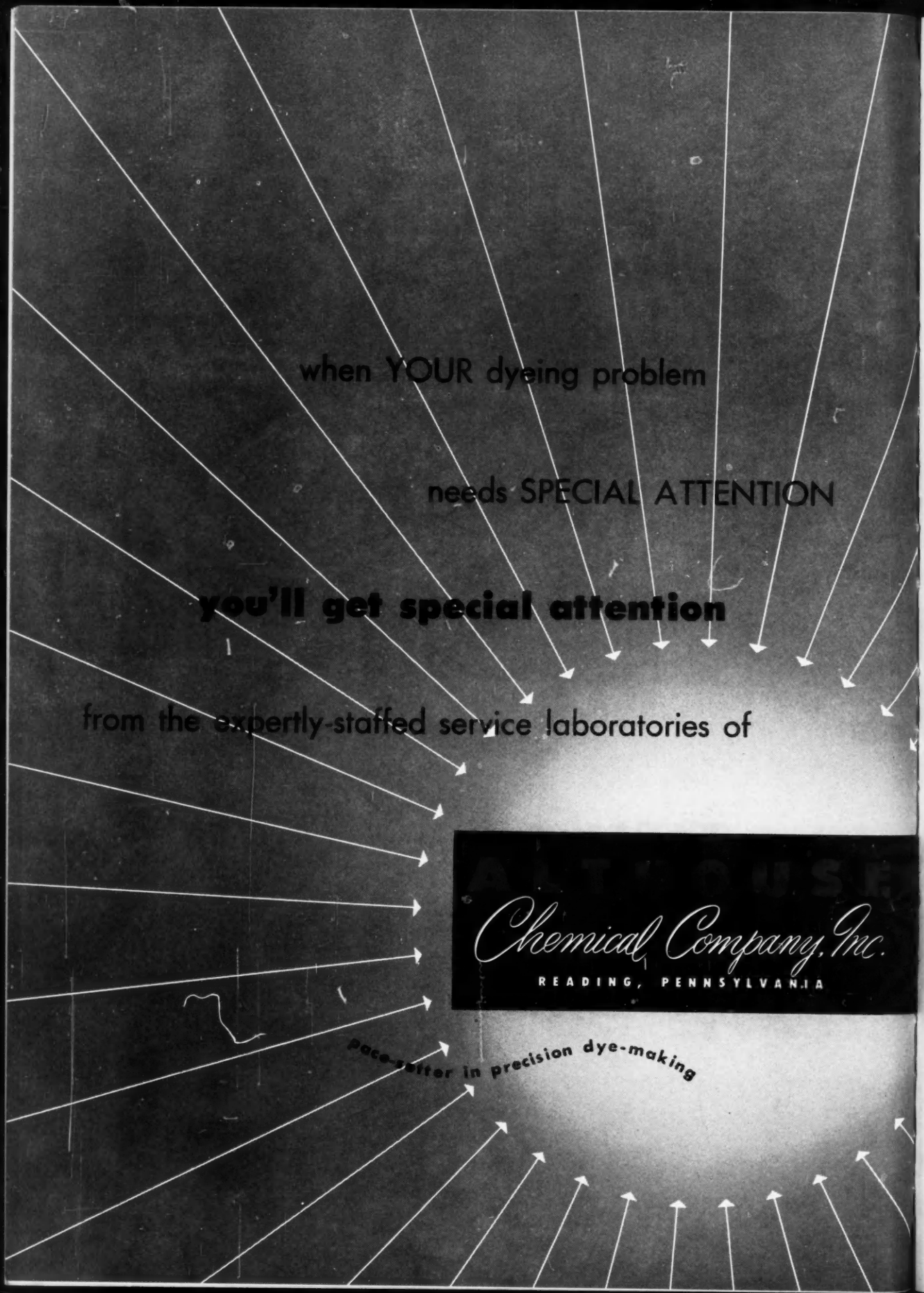
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TEXTILE CHEMISTS AND COLORISTS

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